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FBC 4162

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AIR FORCE FLIGHT DYNAMICS LABORATORY
DIRECTOR OF LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT PATTERSON AIR FORCE BASE OHIO

AF FLIGHT DYNAMICS LABORATORY

USER's INSTRUCTIONS FOR THE COMPUTER PROGRAM PLSTR AS MODIFIED BY AFFDL/FBC

Prepared by

PLSTR

T. Muha

February 1973

COMPUTER PROGRAMS

FOREWORD

This work was conducted by Mr T. J. Muha, Exploratory Development Group, Advanced Composites Branch, at the Air Force Flight Dynamics Laboratory, under Project 4364, "Filamentary Composites Structures."

The manuscript was released by the author in February, 1973. This Technical Memorandum has been reviewed and is approved.

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PART I

GENERAL INFORMATION

1.1 BACKGROUND

PLSTR was written by Dr R. S. Sandhu of the Ohio State University. The coding was based upon the earlier work by Professor Wilson of the University of California at Berkley, but modifications were made to improve the program's efficiency. The present version in use by AFFDL/FBC includes modifications by Mr T. J. Muha to account for orthotropic materials and to permit the output of either maximum and minimum stresses or strains.

1.2 PROGRAM DESCRIPTION

This program performs an elastic, plane stress, finite element, structural analysis. It can handle linearly varying thermal and pressure loads. At the present time it can handle quadrilateral and triangular elements, up to three thousand elements or grid points, up to twelve materials, up to eight temperature points for computing material properties of each material, and pressure acting on up to three hundred elements. The maximum semi-band width is fifty.

The analysis proceeds from

$$Ax = F, \tag{1}$$

where A is the stiffness matrix, x is the displacement matrix, and F is the force matrix.

Having determined the displacements from Equation (1), the strains are assumed to follow from

$$B\varepsilon = x, \tag{2}$$

where B is the matrix linking the strains and the displacements, and ε is the strain matrix.

Finally, taking the strains from Equation (2), the stresses are found from

$$\sigma = C\varepsilon, \tag{3}$$

where σ is the stress matrix and C is the material stiffness matrix. For isotropic materials, Equation (3) is Hooke's Law.

1.3 FUTURE WORK

As stated in Section 1.1, PLSTR has undergone a substantial modification since being received by AFFDL/FBC. Future modifications now being considered are using SPLINE interpolation functions to incorporate non-linear material properties, a plane strain option, the ability to run multiple load cases, and a failure criterion for developing margins of safety.

PART II

INPUT INSTRUCTIONS

The input for PLSTR consists of eight logical cards. It must be noted that a logical card may consist of more than one physical card. For the remainder of this section, a logical card will be referred to simply as a card.

The eight input cards needed to run PLSTR are formatted as follows:

CARD 1: Title

Columns	Format	Variable	Explanation
1 - 80	8A10	HED	Any alphanumeric information necessary to identify the problem

CARD 2: Basic Information

Columns	Format	Variable	Explation
1 - 5	I5	NUMNP	Number of grid points
6 - 10	I5	NUMEL	Number of elements
11 - 15	I5	NUMMAT	Number of materials
16 - 20	I5	NUMPC	Number of pressure cards (See Card 7)
21 - 30	F10.2	ACELR	Acceleration in x-direction
31 - 40	F10.2	ACELZ	Acceleration in y-direction
41 - 50	F10.2	Q	Reference (stress-free) temperature

CARD 3 : Material Identification

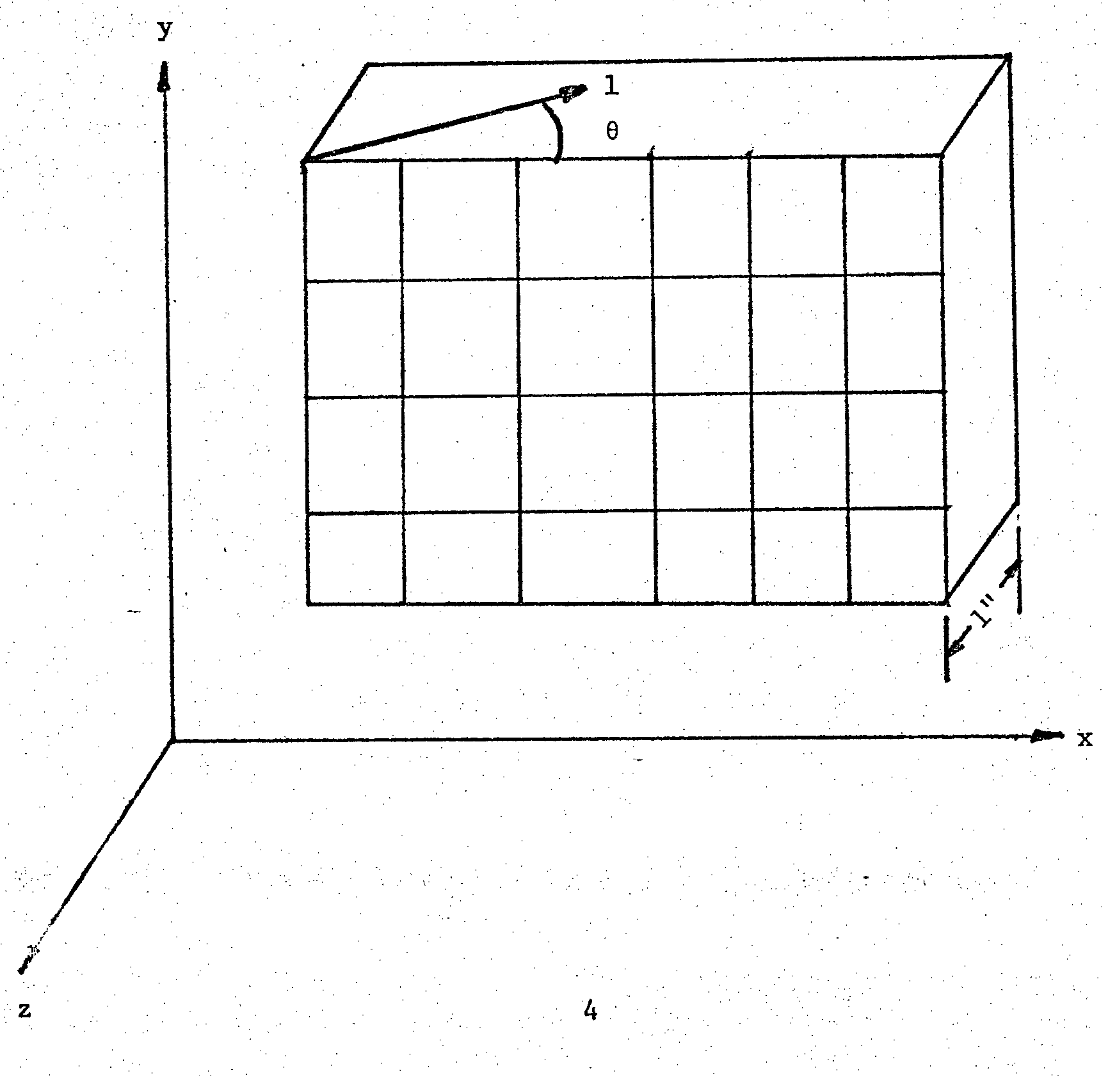
Columns	Format	Variable	Explanation
1 - 5	I5	MTYPE	Material Identification Number
6 - 10	I5	NTC(MTYPE)	Number of temperature cards for material MTYPE (see Card 4)

Columns	Format	Variable	Explanation
11 - 20	F10.0	RO(MTYPE)	Mass density for material MTYPE
21 - 25	I5	NORTHO(MTYPE)	Material type for material MTYPE 0, ISOTROPIC MATERIAL 1, orthotropic material

CARD 3A: Material Orientation (Orthotropic Materials Only)

Columns	Format	Variable	Explanation
1 - 10	F10.0	Angle , θ	Orientation angle of material longitudinal strength direction (fiber direction for dilamentary composites) in x-z plane

Figure 2-1. Grid Geometry



CARD 4A: Material Properties (Isotropic Materials Only)

Columns	Format	Variable	Explanation
1 - 10	F10.3	E(I,1,MTYPE)	Temperature I
11 - 20	F10.3	E(I,2,MTYPE)	Young's Modulus at temperature I
21 - 30	F10.3	E(I,3,MTYPE)	Poisson's Ratio at temperature I
31 - 40	F10.3	E(I,4,MTYPE)	Coefficient of thermal expansion at temperature I

NOTE: Repeat Card 4A for each temperature desired for material MTYPE, i.e., repeat NUMTC(MTYPE) times.

CARD 4B: Material Properties (Orthotropic Materials Only)

Columns	Format	Variable	Explanation
1-10	F10.0	TMAT(MTYPE,I)	Temperature I
11 - 20	F10.0	E11(MTYPE,I)	Longitudinal Young's modulus at temperature I
21 - 30	F10.0	E22(MTYPE,I)	Transverse Young's modulus at temperature I
31 - 40	F10.0	G12(MTYPE,I)	Shear modulus in the 1,2 plane at temperature I
41 - 50	F10.0	AMU12(MTYPE,I)	Poisson's Ratio, ν_{12}, at temperature I
51 - 60	F10.0	A1(MTYPE,I)	Longitudinal coefficient of thermal expansion at temperature I
61 - 70	F10.0	A2(MTYPE,I)	Transverse coefficient of thermal expansion at temperature I
71 - 80	F10.0	A12(MTYPE,I)	Shearing coefficient of thermal expansion, α_{12}, at temperature I

NOTE FOR A12(MTYPE,I) - At this time α_{12} has not been incorporated into the analysis; it has been included in the input with possible future inclusion in mind. For orthotropic materials $\alpha_{12} = 0$).

NOTE: Repeat Card 4B for each temperature desired for material MTYPE, i.e., repeat NUMTC(MTYPE) times.

Cards 3 and 4 are repeated NUMMAT times.

CARD 5: Grid Point Data

Columns	Format	Variable	Explanation
1 - 5	I5	N	Grid point number
6 - 10	F5.1	CODE(N)	Boundary condition flag for grid point N: 0, UR(N) and UZ(N) are x and y loads 1, UR(N) is x-displacement and UZ(N) is y-load 2, UR(N) is x-load and UZ(N) is y-displacement 3, UR(N) and UZ(N) are x and y displacements
11 - 20	F10.4	R(N)	X-coordinate of grid point N
21 - 30	F10.4	Z(N)	Y-coordinate of grid point N
31 - 40	F10.4	UR(N)	X-load or displacement of grid point N(See CODE(N) above)
41 - 50	F10.4	UZ(N)	Y-load or displacement of grid point N (See CODE(N) above)
51 - 60	F10.4	T(N)	Temperature of grid point N

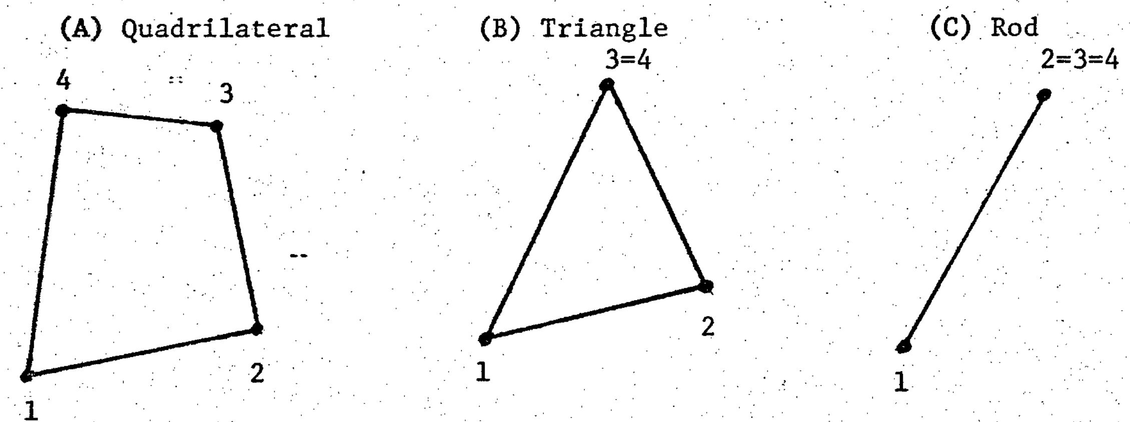
Card 5 is repeated to input the entire grid system. The repetition is performed either for every grid point or for those grid points required by the mesh generator within PLSTR (See Appendix A).

CARD 6: Element Data

Columns	Format	Variable	Explanation
1 - 5	I5	M	Element number
6 - 10	I5	IX(M,1)	First grid point for element M
11 - 15	I5	IX(M,2)	Second grid point for element M
16 - 20	I5	IX(M,3)	Third grid point for element M
21 - 25	I5	IX(M,4)	Fourth grid point for element M
26 - 30	I5	IX(M,5)	Material identification for element M

As for Card 5, Card 6 is repeated either for every element or for those elements required by PLSTR's mesh generator (See Appendix A). The sequencing of grid points for an element is counter clockwise as shown in Figure 2-2.

Figure 2-2 Element Grid Point Sequencing



NOTE: Four grid points must be input for each element type.

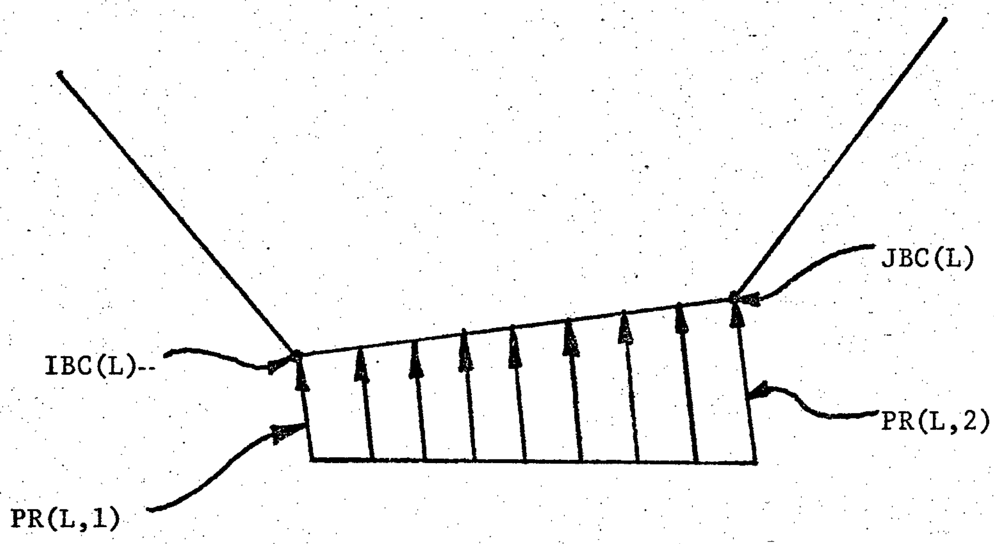
CARD 7: Pressure Data (If NUMPC is greater than zero)

Columns	Format	Variable	Explanation
1 - 5	I5	IBC(L)	First pressure grid point
6 - 10	I5	JBC(L)	Second pressure grid point
11 - 20	F10.3	PR(L,1)	Pressure acting at IBC
21 - 30	F10.3	PR(L,2)	Pressure acting at JBC

Card 7 is repeated NUMPC times (See Card 2). The grid points are sequenced in a counter clockwise manner as you proceed around the perimeter of the

grid (See Figure 2-3). A linear distribution is assumed along the element face.

Figure 2-3 Pressure Card Nomenclature



CARD 8: Output Selection

Columns	Format	Variable	Explanation
1 - 5	I5	NPRT	Stress-Strain output flag 0, print for each element El. No., x,y, x-stress, y-stress, xy-stress, max-stress, min-stress, and angle 1, print for each element El. No., x,y, x-stress, y-stress, xy-stress, x-strain, y-strain, and xy-strain

APPENDIX A

PLSTR MESH GENERATOR

The mesh generator in PLSTR is loacted between labeled statement 60 (Line 34) and labeled statement 190 (Line 68) of the main program (See Appendix B). This generation scheme is useful in reducing the required number of physical input cards when many orderly, similarly sized elements occur in the grid.

The impact on grid cards needed is that, if the N + 1 consecutive grid points, M to M + N, are evenly spaced the variable, CODE, for each of these points is zero, and no loads are applied only the grid points M and M + N need be entered. The generator will calculate

$$DX = \frac{X_{M+N}-X_M}{N}$$

and

$$DY = \frac{Y_{M+N}-Y_M}{N}$$

Then the mesh generator will assign

$$X_{M+1} = X_M + DX, \quad Y_{M+1} = Y_M + DY$$

$$X_{N+2} = X_{M+1} + DX, \quad Y_{M+2} = Y_{M+1} + DY$$

Temperature will be handled in the same manner, and CODE for all generated points will be set to zero.

The impact of the mesh generator on the number of element cards needed is similar to the impact on grid cards. If the N + 1 consecutive elements, M to M + N, have grid points progressing by ones, and the material is the same for all N + 1 elements, only the elements M and M + N need be entered. The mesh generator will assign

$$IX(J,K) = IX(J-1,K) + 1 \quad J = M+1, M+N; \ K=1,4$$

and

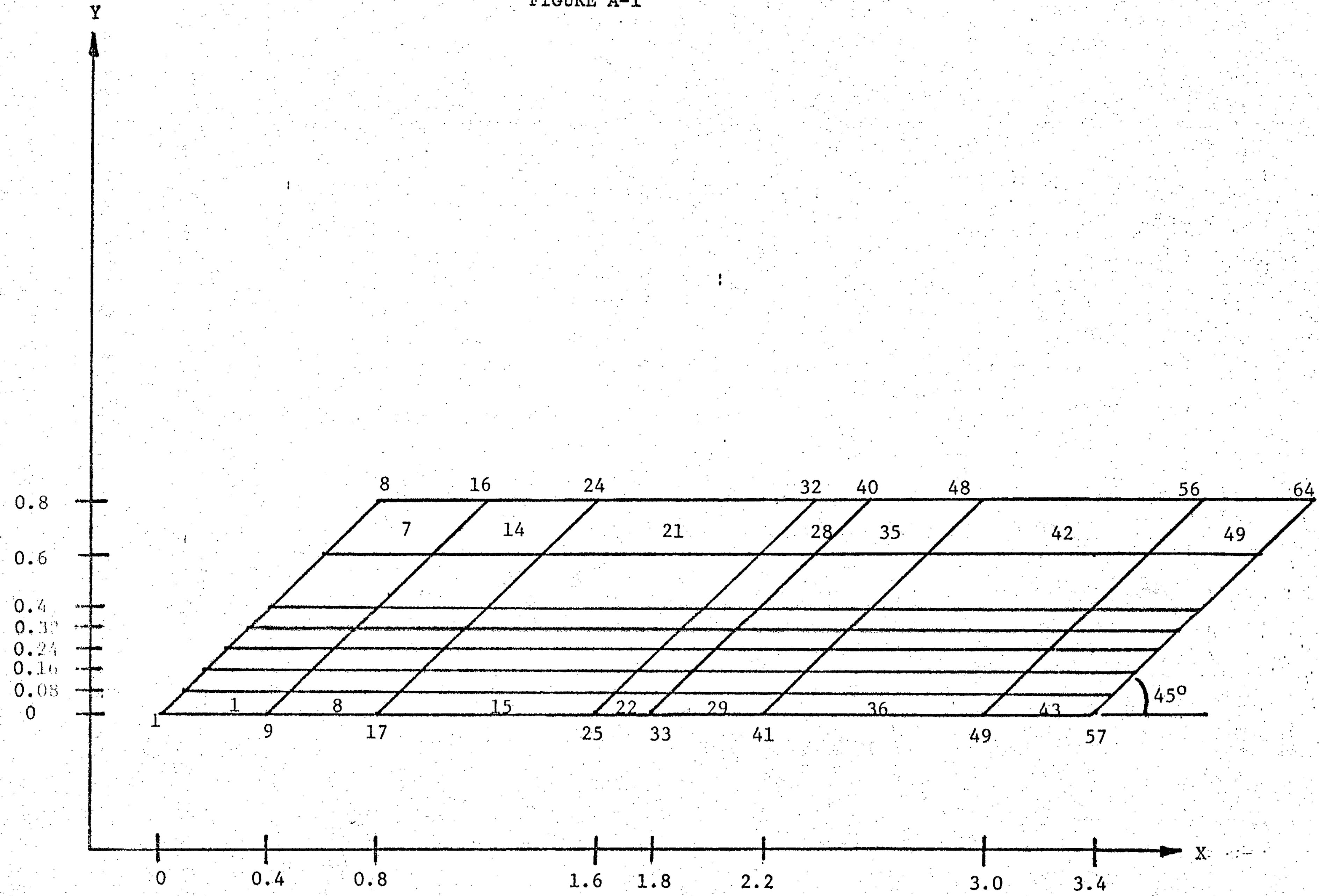
$$IX(J,5) = IX(M,5) \quad J = M+1, M+N-1$$

The following examples will illustrate the use and effect of the mesh generator.

<u>EXAMPLE 1</u>. Take a grid consisting of 64 grid points and 49 elements (See Figure A-1). In this problem, assume material 1 exists from Y = 0.0 to 0.32, and material 2 exists from Y = 0.32 to 0.8. Also assume that no points are constrained, i.e., CODE is zero everywhere. Without a mesh generator, 64 grid point cards and 49 element cards would be needed.

The grid points which <u>must</u> be input for this problem are 1,6,8,9,14, 16,17,22,24,25,30,32,33,38,40,41,46,48,49,54,56,57,62,64. Thus, only 24 grid points need be input instead of 64. The elements which <u>must</u> be input are 1,4,5,7,8,11,12,14,15,18,19,21,22,25,26,28,29,32,33,35,36,39,40,42,43, 46,47,49. Therefore, only 28 elements need be input instead of 49. In this problem, the mesh generator causes 61 fewer cards to be required.

FIGURE A-1



Y
X
0.8
0.6
0.4
0.32
0.24
0.16
0.08
0
0
0.4
0.8
1.6
1.8
2.2
3.0
3.4
45°
8
16
24
32
40
48
56
64
7
14
21
28
35
42
49
1
8
15
22
29
36
43
1
9
17
25
33
41
49
57

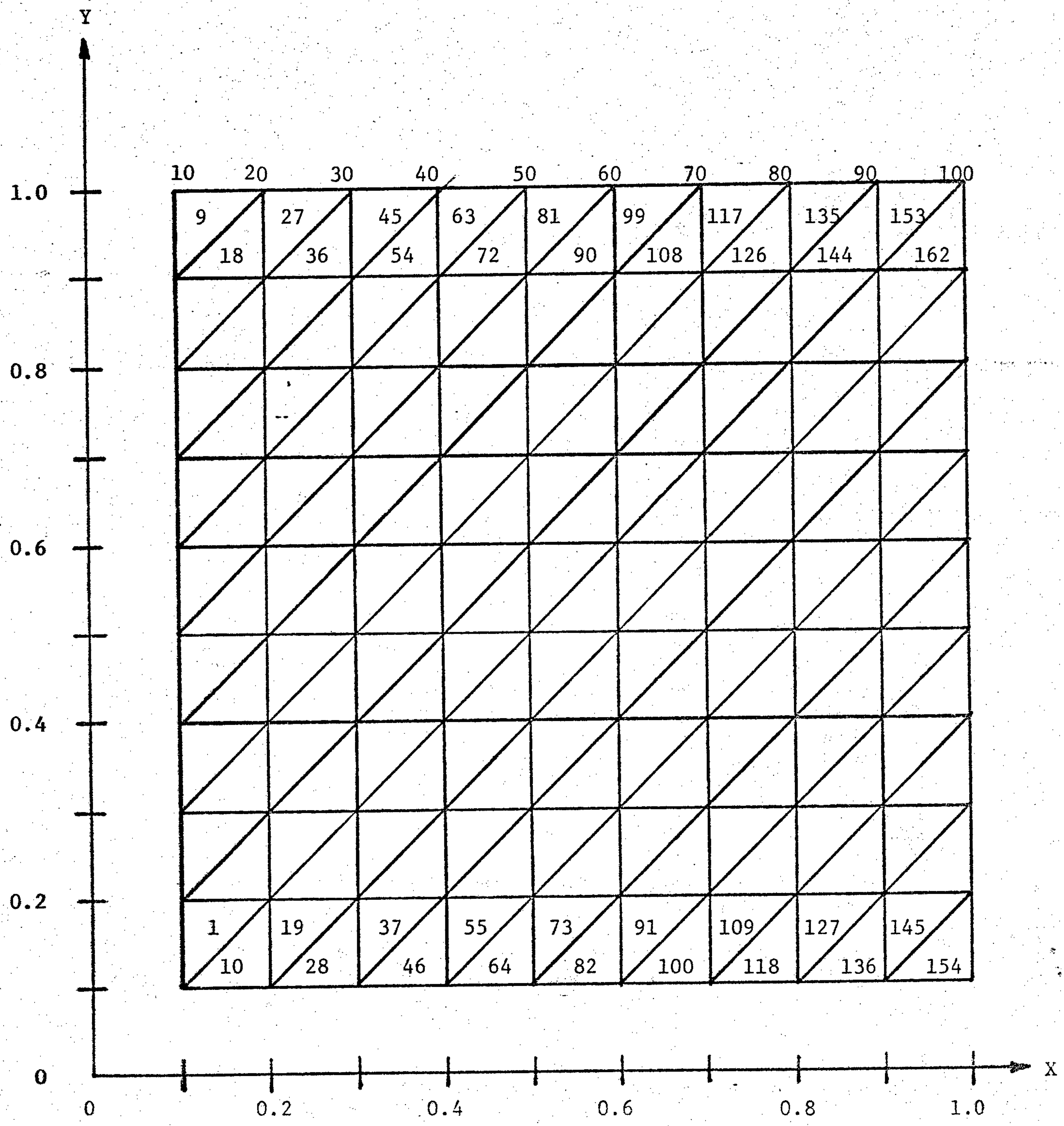
EXAMPLE 2. Take the same grid as in example 1. Assume, this time, that loads are applied at grid points 1 to 8, a zero x-displacement is imposed at grid points 57 to 64, and only one material is used.

The grid points which must be input for this problem are 1-8,9,14,16,17, 22,24,25,30,32,33,38,40,41,46,48,49,54,56,57-64. The elements which must be input are 1,7,8,14,15,21,22,28,29,35,36,42,43, and 49. Since only 34 grid points and 14 elements are input, 65 fewer data cards are required because of the mesh generator.

EXAMPLE 3. Take a grid consisting of 100 grid points and 162 elements (See Figure A-2). Assume one material, no loads, and no constraints. Without the mesh generator, 262 data cards would be required.

The grid points which must be input are 1, 10,11,20,21,30,31,40,41,50, 51,60,61,70,71,80,81,90,91, and 100. The elements which must be input are 1,9,10,18,19,27,28,36,37,45,46,54,55,63,64,72,73,81,82,90,91,99,100, 108,109,117,118,126,127,135,136,144,145,153,154, and 162. Thus, only 56 cards are required, instead of 262.

Figure A-2


Y
X
1.0
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1.0
10
20
30
40
50
60
70
80
90
100
9
18
27
36
45
54
63
72
81
90
99
108
117
126
135
144
153
162
1
10
19
28
37
46
55
64
73
82
91
100
109
118
127
136
145
154

APPENDIX B

PROGRAM LISTING

```
      PROGRAM PLSTR(INPUT,OUTPUT,PUNCH,TAPE1,TAPE2,TAPE5=INPUT,TAPE6=OUT
     1PUT)
C     ARBITRARY TWO DIMENSIONAL STRUCTURES
C     LINEAR PRESSURE BOUNDARY
C     PROGRAMMED BY R.S.SANDHU, THE OHIO STATE UNIVERSITY, COLUMBUS     MAIN
      COMMON NUMNP,NUMEL,NUMMAT,NUMPC,ACELR,ACELZ,N,JOL,TEMP,MTYPE,Q,   MAIN
     1 HED(8),E(8,4,12),RO(12),NTC(8),R(3000),Z(3000),UR(3000),UZ(3000),
     2 CODE(3000),T(3000),IBC(300),JBC(300),PR(300,2)
      COMMON/ARG/C(3,3),S(10,10),SIG(6),P(8),ST(3,10),RR(5),ZZ(5),LM(4),
     1           EE(7),IX(3000,5),XC,YC
      COMMON/ORTHO/NORTHO(12),ANGLE(12),TH(12),S1(12),S2(12),S3(12),
     1              S4(12),S5(12),S6(12),S7(12),S8(12),E11(12,8),
     2              E22(12,8),G12(12,8),AMU12(12,8),A1(12,8),A2(12,8),
     3              A12(12,8),TMAT(12,8)
      COMMON/BANARG/MBAND,NUMBLK,B(200),A(200,100)
   30 READ  (5,1000) HED,NUMNP,NUMEL,NUMMAT,NUMPC,ACELR,ACELZ,Q         MAIN
      IF(EOF(5)) 123,31
   31 CONTINUE                                                          MAIN
      WRITE (6,2000) HED,NUMNP,NUMEL,NUMMAT,NUMPC,ACELR,ACELZ,Q         MAIN
   40 DO 50 M=1,NUMMAT
      READ(5,1001) MTYPE,NTC(MTYPE),RO(MTYPE),NORTHO(MTYPE)
      WRITE(6,2001) MTYPE,NTC(MTYPE),RO(MTYPE),NORTHO(MTYPE)            MAIN
      NUMTC=NTC(MTYPE)
      NXN=NORTHO(MTYPE)
      IF(NXN.GT.0) GO TO 51
      READ(5,1002) ((E(I,J,MTYPE),J=1,4),I=1,NUMTC)
      WRITE(6,2002)((E(I,J,MTYPE),J=1,4),I=1,NUMTC)
      GO TO 50
   51 CALL ORTHOG(MTYPE,NUMTC)                                          MAIN
   50 CONTINUE                                                          MAIN
      WRITE (6,2003)
      L=1
      NL=1
   60 READ  (5,1003) N,CODE(N),R(N),Z(N),UR(N),UZ(N),T(N)               MAIN
      IF(N.EQ.1) GO TO 90                                               MAIN
      NL=L+1                                                            MAIN
      ZX=N-L                                                            MAIN
      DR=(R(N)-R(L))/ZX                                                 MAIN
      DZ=(Z(N)-Z(L))/ZX                                                 MAIN
      DT=(T(N)-T(L))/ZX                                                 MAIN
   70 L=L+1                                                             MAIN
      IF(N-L) 100,90,80                                                 MAIN
   80 CODE(L)=0.0                                                       MAIN
      R(L)=R(L-1)+DR                                                    MAIN
      Z(L)=Z(L-1)+DZ                                                    MAIN
      T(L)=T(L-1)+DT                                                    MAIN
      UR(L)=0.0                                                         MAIN
      UZ(L)=0.0                                                         MAIN
      GO TO 70                                                          MAIN
   90 WRITE (6,2004)  (K,CODE(K),R(K),Z(K),UR(K),UZ(K),T(K),K=NL,N)     MAIN
      IF(NUMNP-N) 100,110,60                                            MAIN
  100 WRITE (6,2005) N                                                  MAIN
      CALL EXIT                                                         MAIN
  110 CONTINUE                                                          MAIN
      WRITE (6,2006)                                                    MAIN
```

```
      N=0
  130 READ (5,1004) M,(IX(M,I),I=1,5)
  140 N=N+1
      IF (M-N) 170,170,150
  150 IX(N,1)=IX(N-1,1)+1
      IX(N,2)=IX(N-1,2)+1
      IX(N,3)=IX(N-1,3)+1
      IX(N,4)=IX(N-1,4)+1
      IX(N,5)=IX(N-1,5)
  170 WRITE (6,2007) N,(IX(N,I),I=1,5)
      IF (M-N) 180,180,140
  180 IF (NUMEL-N) 190,190,130
  190 CONTINUE
      IF (NUMPC) 290,310,290
  290 WRITE (6,2008)
      DO 300 L=1,NUMPC
      READ(5,1005) IBC(L),JBC(L),PR(L,1),PR(L,2)
  300 WRITE(6,2009) IBC(L),JBC(L),PR(L,1),PR(L,2)
  310 CONTINUE
      READ (5,1006) NPRT
      J=0
      DO 340 N=1,NUMEL
      DO 340 I=1,4
      DO 325 L=1,4
      KK=IABS(IX(N,I)-IX(N,L))
      IF (KK-J) 325,325,320
  320 J=KK
  325 CONTINUE
  340 CONTINUE
      MBAND=2*J+2
  350 CALL STIFF
      CALL BANSOL
      WRITE (6,2010) (N,B(2*N-1),B(2*N),N=1,NUMNP)
      CALL STRESS(NPRT)
      DO 360 I=1,NUMNP
      J=2*I-1
      K=2*I
  360 CONTINUE
 1000 FORMAT (8A10/4I5,3F10.2)
 1001 FORMAT (2I5,F10.0,I5)
 1002 FORMAT (4F10.3)
 1003 FORMAT (I5,F5.1,5F10.4)
 1004 FORMAT (6I5)
 1005 FORMAT(2I5,2F10.3)
 1006 FORMAT (I5)
 2000 FORMAT (1H1,8A10/
     1 30H0 NUMBER OF NODAL POINTS------ I5 /
     2 30H0 NUMBER OF ELEMENTS---------- I5 /
     3 30H0 NUMBER OF DIFF. MATERIALS--- I3 /
     4 30H0 NUMBER OF PRESSURE CARDS---- I3 /
     5 30H0 X-ACCELERATION-------------- E12.4/
     6 30H0 Y-ACCELERATION-------------- E12.4/
     7 30H0 REFERENCE TEMPERATURE------- E12.4)
 2001 FORMAT (* MATERIAL NUMBER= *,I3,*, NUMBER OF TEMPERATURE CARDS= *,
     1        I3,*, MASS DENSITY= *,E12.4,*, NORTHO= *,I3)
```

```
2002 FORMAT (15H0  TEMPERATURE 10X 5HE      9X 6HNU      10X 5HALPHA/     MAIN
    1(F15.2,3E15.5))                                                      MAIN
2003 FORMAT (108H1NODAL POINT        TYPE  X ORDINATE  Y ORDINATE  X LOMAIN
    1AD OR DISPLACEMENT  Y LOAD OR DISPLACEMENT TEMPERATURE )            MAIN
2004 FORMAT (I12,F12.2,2F12.5,2E24.7,F12.3)
2005 FORMAT (26H0NODAL POINT CARD ERROR N= I5)                           MAIN
2006 FORMAT (49H1ELEMENT NO.      I     J     K     L    MATERIAL  )     MAIN
2007 FORMAT (1I13,4I6,1I12)                                              MAIN
2008 FORMAT(29H0PRESSURE BOUNDARY CONDITIONS/40H      I     J    PRESSURMAIN
    1E I      PRESSURE J)                                                MAIN
2009 FORMAT(2I6,2F14.3)                                                  MAIN
2010 FORMAT (12H1N.P. NUMBER 18X 2HUX 18X 2HUY / (1I12,2E20.7))          MAIN
3000 FORMAT (2E20.7)
     GO TO 30 ;
 123 STOP                                                                MAIN
     END
```

```
SYMBOLIC REFERENCE MAP

ENTRY POINTS
 5150  PLSTR

VARIABLES     SN  TYPE             RELOCATION
  312  A          REAL      ARRAY   BANARG         4  ACELR    REAL               / /
    5  ACELZ      REAL              / /          644  AMU12    REAL      ARRAY    ORTHO
   14  ANGLE      REAL      ARRAY   ORTHO       1004  A1       REAL      ARRAY    ORTHO
 1304  A12        REAL      ARRAY   ORTHO       1144  A2       REAL      ARRAY    ORTHO
    2  B          REAL      ARRAY   BANARG         0  C        REAL      ARRAY    ARG
30207  CODE       REAL      ARRAY   / /         6060  DR       REAL
 6062  DT         REAL                          6061  DZ       REAL
   23  E          REAL      ARRAY   / /          247  EE       REAL      ARRAY    ARG
  204  E11        REAL      ARRAY   ORTHO        344  E22      REAL      ARRAY    ORTHO
  504  G12        REAL      ARRAY   ORTHO         13  HED      REAL      ARRAY    / /
 6053  I          INTEGER                      43767  IBC      INTEGER   ARRAY    / /
  256  IX         INTEGER   ARRAY   ARG         6054  J        INTEGER
44443  JBC        INTEGER   ARRAY   / /         6063  K        INTEGER
 6065  KK         INTEGER                       6055  L        INTEGER
  243  LM         INTEGER   ARRAY   ARG         6050  M        INTEGER
    0  MBAND      INTEGER           BANARG        11  MTYPE    INTEGER            / /
    6  N          INTEGER           / /         6056  NL       INTEGER
    0  NORTHO     INTEGER   ARRAY   ORTHO       6064  NPRT     INTEGER
  637  NTC        INTEGER   ARRAY   / /            1  NUMBLK   INTEGER            BANARG
    1  NUMEL      INTEGER           / /            2  NUMMAT   INTEGER            / /
    0  NUMNP      INTEGER           / /            3  NUMPC    INTEGER            / /
 6051  NUMTC      INTEGER                       6052  NXN      INTEGER
  163  P          REAL      ARRAY   ARG        45117  PR       REAL      ARRAY    / /
   12  Q          REAL              / /          647  R        REAL      ARRAY    / /
  623  RO         REAL      ARRAY   / /          231  RR       REAL      ARRAY    ARG
   11  S          REAL      ARRAY   ARG          155  SIG      REAL      ARRAY    ARG
  173  ST         REAL      ARRAY   ARG           44  S1       REAL      ARRAY    ORTHO
   60  S2         REAL      ARRAY   ORTHO         74  S3       REAL      ARRAY    ORTHO
  110  S4         REAL      ARRAY   ORTHO        124  S5       REAL      ARRAY    ORTHO
  140  S6         REAL      ARRAY   ORTHO        154  S7       REAL      ARRAY    ORTHO
  170  S8         REAL      ARRAY   ORTHO      36077  T        REAL      ARRAY    / /
   10  TEMP       REAL              / /           30  TH       REAL      ARRAY    ORTHO
 1444  TMAT       REAL      ARRAY   ORTHO      14427  UR       REAL      ARRAY    / /
22317  UZ         REAL      ARRAY   / /            7  VOL      REAL               / /
35506  XC         REAL              ARG        35507  YC       REAL               ARG
 6537  Z          REAL      ARRAY   / /         6057  ZX       REAL
  236  ZZ         REAL      ARRAY   ARG

FILE NAMES        MODE
    0  INPUT               1023  OUTPUT              2046  PUNCH                3071  TAPE1
 4114  TAPE2                  0  TAPE5      FMT      1023  TAPE6      FMT

EXTERNALS         TYPE   ARGS
       BANSOL               0                       EOF      REAL       1
       EXIT                 0                       ORTHOG              2
       STIFF                0                       STRESS              1
```

```
INLINE FUNCTIONS   TYPE    ARGS
       IABS        INTEGER   1  INTRIN

STATEMENT LABELS
 5151  30                                  0   31            INACTIVE                0   40              INACTIVE
 5315  50                               5313   51                                 5325   60
 5363  70                                  0   80            INACTIVE             5400   90
 5431  100                              5440  110                                 5645  123
 5444  130                              5461  140                                    0  150              INACTIVE
 5474  170                                 0  180            INACTIVE                0  190              INACTIVE
    0  290           INACTIVE              0  300                                 5554  310
    0  320           INACTIVE           5577  325                                    0  340
    0  350           INACTIVE              0  360                                 5660 1000      FMT
 5663  1001      FMT                    5666 1002      FMT                        5670 1003      FMT
 5673  1004      FMT                    5675 1005      FMT                        5700 1006      FMT
 5702  2000      FMT                    5736 2001      FMT                        5751 2002      FMT
 5761  2003      FMT                    5776 2004      FMT                        6003 2005      FMT
 6010  2006      FMT                    6017 2007      FMT                        6022 2008      FMT
 6033  2009      FMT                    6036 2010      FMT                        6044 3000      FMT  NO REFS

COMMON BLOCKS   LENGTH
        / /      19623
        ARG      15176
        ORTHO      900
        BANARG   20202

STATISTICS
  PROGRAM LENGTH     731B      473
    BUFFER LENGTH   5137B     2655
    COMMON LENGTH 106666B    36278
     BLANK COMMON  46247B    19623
```

```
      SUBROUTINE STIFF
      COMMON NUMNP,NUMEL,NUMMAT,NUMPC,ACELR,ACELZ,N,VOL,TEMP,MTYPE,1,
     1 HED(8),E(8,4,12),RO(12),NTC(8),R(3000),Z(3000),UR(3000),UZ(3000),
     2 CODE(3000),T(3000),IBC(300),JBC(300),PR(300,2)
      COMMON/ARG/C(3,3),S(10,10),SIG(6),P(8),ST(3,10),RR(5),ZZ(5),LM(4),
     1           EE(7),IX(3000,5),XC,YC
      COMMON/BANARG/MBAND,NUMBLK,B(200),A(200,100)
      REWIND 2
      NB=50
      ND=2*NB
      ND2=2*ND
      STOP=0.0
      NUMBLK=0
      DO 50 N=1,ND2
      B(N)=0.0
      DO 50 M=1,ND
   50 A(N,M)=0.0
   60 NUMBLK=NUMBLK+1
      NH=NB*(NUMBLK+1)
      NM=NH-NB
      NL=NM-NB+1
      KSHIFT=2*NL-2
      DO 210 N=1,NUMEL
      IF (IX(N,5)) 210,210,65
   65 DO 80 I=1,4
      IF (IX(N,I)-NL) 80,70,70
   70 IF (IX(N,I)-NM) 90,90,80
   80 CONTINUE
      GO TO 210
   90 IF(IX(N,3)-IX(N,2)) 95,85,95
   85 CALL ONED
      IX(N,5)=-IX(N,5)
      MM=2
      GO TO 130
   95 CALL QUAD
      IX(N,5)=-IX(N,5)
      IF(VOL) 100,100,110
  100 WRITE(6,2000) N
      STOP=1.0
  110 MM=4
      IF(IX(N,3)-IX(N,4)) 130,120,130
  120 MM=3
  130 DO 140 I=1,MM
  140 LM(I)=2*IX(N,I)-2
      DO 200 I=1,MM
      DO 200 K=1,2
      II=LM(I)+K-KSHIFT
      KK=2*I-2+K
      B(II)=B(II)+P(KK)
      DO 200 J=1,MM
      DO 200 L=1,2
      JJ=LM(J)+L-II+1-KSHIFT
      LL=2*J-2+L
      IF(JJ) 200,200,175
  175 IF(ND-JJ) 180,195,195
```

```
  180 WRITE (6,2001) N                                    STIF
      STOP=1.0                                            STIF
      GO TO 210                                           STIF
  195 A(II,JJ)=A(II,JJ)+S(KK,LL)                          STIF
  200 CONTINUE                                            STIF
  210 CONTINUE                                            STIF
      DO 220 N=NL,NM                                      STIF
      IF(N-NUMNP) 215,215,220
  215 K=2*N-KSHIFT
      B(K)=B(K)+UZ(N)                                     STIF
      B(K-1)=B(K-1)+UR(N)
  220 CONTINUE
      IF(NUMPC) 225,310,225                               STIF
  225 DO 300 L=1,NUMPC                                    STIF
      I=IBC(L)                                            STIF
      J=JBC(L)                                            STIF
      DR=Z(I)-Z(J)                                        STIF
      DZ=R(J)-R(I)                                        STIF
      PP2=(PR(L,2)+PR(L,1))/6.                            STIF
      PP1=PP2+PR(L,1)/6.                                  STIF
      PP2=PP2+PR(L,2)/6.                                  STIF
      II=2*I-KSHIFT                                       STIF
      JJ=2*J-KSHIFT                                       STIF
      IF(II) 265,265,235                                  STIF
  235 IF(II-ND) 240,240,265                               STIF
  240 B(II-1)=B(II-1)+PP1*DR                              STIF
      B(II)=B(II)+PP1*DZ                                  STIF
  265 IF(JJ) 300,300,270                                  STIF
  270 IF(JJ-ND) 275,275,300                               STIF
  275 B(JJ-1)=B(JJ-1)+PP2*DR                              STIF
      B(JJ)=B(JJ)+PP2*DZ                                  STIF
  300 CONTINUE                                            STIF
  310 DO 400 M=NL,NH                                      STIF
      IF (M-NUMNP) 315,315,400                            STIF
  315 U=UR(M)                                             STIF
      N=2*M-1-KSHIFT                                      STIF
      IF (CODE(M)) 390,400,316                            STIF
  316 IF (CODE(M)-1.) 317,370,317                         STIF
  317 IF (CODE(M)-2.) 318,390,318                         STIF
  318 IF (CODE(M)-3.) 390,380,390                         STIF
  370 CALL MODIFY(A,B,ND2,MBAND,N,U)                      STIF
      GO TO 400                                           STIF
  380 CALL MODIFY(A,B,ND2,MBAND,N,U)                      STIF
  390 U=UZ(M)                                             STIF
      N=N+1                                               STIF
      CALL MODIFY(A,B,ND2,MBAND,N,U)                      STIF
  400 CONTINUE                                            STIF
      WRITE (2) (B(N),(A(N,M),M=1,MBAND),N=1,ND)          STIF
      DO 420 N=1,ND                                       STIF
      K=N+ND                                              STIF
      B(N)=B(K)                                           STIF
      B(K)=0.0                                            STIF
      DO 420 M=1,ND                                       STIF
      A(N,M)=A(K,M)                                       STIF
  420 A(K,M)=0.0                                          STIF
```

```
      IF (NM-NUMNP) 60,480,480                                    STIF
  480 CONTINUE                                                    STIF
      IF(STOP) 490,500,490                                        STIF
  490 CALL EXIT                                                   STIF
  500 RETURN                                                      STIF
 2000 FORMAT (26H0NEGATIVE AREA ELEMENT NO. I4)                   STIF
 2001 FORMAT (29H0BAND WIDTH EXCEEDS ALLOWABLE I4)                STIF
      END                                                         STIF
```

```
        SYMBOLIC REFERENCE MAP

 ENTRY POINTS
     1  STIFF

 VARIABLES       SN  TYPE           RELOCATION
    312  A            REAL        ARRAY   BANARG            4  ACELR     REAL                 / /
      5  ACELZ        REAL                / /               2  B         REAL        ARRAY    BANARG
      0  C            REAL        ARRAY   ARG           30207  CODE      REAL        ARRAY    / /
    433  DR           REAL                                434  DZ        REAL
     23  E            REAL        ARRAY   / /             247  EE        REAL        ARRAY    ARG
     13  HED          REAL        ARRAY   / /             422  I         INTEGER
  43767  IDC          INTEGER     ARRAY   / /             425  II        INTEGER
    256  IX           INTEGER     ARRAY   ARG             427  J         INTEGER
  44443  JBG          INTEGER     ARRAY   / /             431  JJ        INTEGER
    424  K            INTEGER                             426  KK        INTEGER
    421  KSHIFT       INTEGER                             430  L         INTEGER
    432  LL           INTEGER                             243  LM        INTEGER     ARRAY    ARG
    415  M            INTEGER                               0  MBAND     INTEGER              BANARG
    423  MM           INTEGER                              11  MTYPE     INTEGER              / /
      6  N            INTEGER             / /             411  NB        INTEGER
    412  NJ           INTEGER                             413  ND2       INTEGER
    416  NH           INTEGER                             420  NL        INTEGER
    417  NI           INTEGER                             637  NTC       INTEGER     ARRAY    / /
      1  NUMBLK       INTEGER             BANARG            1  NUMEL     INTEGER              / /
      2  NUMMAT       INTEGER             / /               0  NUMNP     INTEGER              / /
      3  NUMPC        INTEGER             / /             163  P         REAL        ARRAY    ARG
    436  PP1          REAL                                435  PP2       REAL
  45117  PR           REAL        ARRAY   / /              12  Q         REAL                 / /
    647  R            REAL        ARRAY   / /             623  RO        REAL        ARRAY    / /
    231  RR           REAL        ARRAY   ARG              11  S         REAL        ARRAY    ARG
    155  SIG          REAL        ARRAY   ARG             173  ST        REAL        ARRAY    ARG
    414  STOP         REAL                              36077  T         REAL        ARRAY    / /
     10  TEMP         REAL                / /             437  U         REAL
  14427  UR           REAL        ARRAY   / /           22317  UZ        REAL        ARRAY    / /
      7  VOL          REAL                / /           35506  XC        REAL                 ARG
  35507  YC           REAL                ARG            6537  Z         REAL        ARRAY    / /
    236  ZZ           REAL        ARRAY   ARG

 FILE NAMES          MODE
         TAPE2       UNFMT                TAPE6        FMT

 EXTERNALS           TYPE   ARGS
         EXIT                0                             MODIFY                 6
         ONED                0                             QUAD                   0

 STATEMENT LABELS
      0  50                              24  60                            0  65            INACTIVE
      0  70       INACTIVE               51  80                            0  85            INACTIVE
     53  90                              63  95                            0  100           INACTIVE
     77  110                              0  120   INACTIVE              104  130
      0  140                              0  175   INACTIVE                0  180           INACTIVE
    150  195                            157  200                         171  210
      0  215      INACTIVE              211  220                           0  225           INACTIVE
```

```
STATEMENT LABELS
    0  235     INACTIVE          0  240     INACTIVE        245  265
    0  270     INACTIVE          0  275     INACTIVE        255  300
  257  310                       0  315     INACTIVE          0  316     INACTIVE
    0  317     INACTIVE          0  318     INACTIVE        302  370
  305  380                     307  390                     314  400
    0  420                       0  480     INACTIVE          0  490     INACTIVE
  362  500                     372  2000    FMT             377  2001    FMT

COMMON BLOCKS   LENGTH
       / /      19623
       ARG      15176
       BANARG   20202

STATISTICS
  PROGRAM LENGTH     440B      288
   COMMON LENGTH  105062B    35378
    BLANK COMMON   45247B    19623
```

```
      SUBROUTINE ONED
      COMMON NUMNP,NUMEL,NUMMAT,NUMPC,ACELR,ACELZ,N,VOL,TEMP,MTYPE,1,      MAIN
     1 HED(8),E(8,4,12),RO(12),NTC(8),R(3000),Z(3000),UR(3000),UZ(3000),
     2 CODE(3000),T(3000),IBC(300),JBC(300),PR(300,2)
      COMMON/ARG/C(3,3),S(10,10),SIG(6),P(8),ST(3,10),RR(5),ZZ(5),LM(4),
     1            EE(7),IX(3000,5),XC,YC
      COMMON/BANARG/MBAND,NUMBLK,B(200),A(200,100)
C
      DO 100 I=1,8
      P(I)=0.0
      DO 100 J=1,8
  100 S(I,J)=0.0
      MTYPE=IX(N,5)
      I=IX(N,1)
      J=IX(N,2)
      DX=R(J)-R(I)
      DY=Z(J)-Z(I)
      XL=SQRT(DX**2+DY**2)
      COSA=DX/XL
      SINA=DY/XL
      COMM=E(1,2,MTYPE)*E(1,4,MTYPE)/XL
C
      S(1,1)=COSA*COSA*COMM
      S(1,2)=COSA*SINA*COMM
      S(1,3)=-S(1,1)
      S(1,4)=-S(1,2)
      S(2,1)=S(1,2)
      S(2,2)=SINA*SINA*COMM
      S(2,3)=-S(1,2)
      S(2,4)=-S(2,2)
      S(3,1)=S(1,3)
      S(3,2)=S(2,3)
      S(3,3)=S(1,1)
      S(3,4)=S(1,2)
      S(4,1)=S(1,4)
      S(4,2)=S(2,4)
      S(4,3)=S(3,4)
      S(4,4)=S(2,2)
C
      EP=E(1,3,MTYPE)/E(1,2,MTYPE)
      DX=DX*EP
      DY=DY*EP
      P(1)=S(1,1)*DX+S(1,2)*DY
      P(2)=S(2,1)*DX+S(2,2)*DY
      P(3)=-P(1)
      P(4)=-P(2)
C
      RETURN
C
      END
```

```
         SYMBOLIC REFERENCE MAP

ENTRY POINTS
    1  ONED

VARIABLES      SN  TYPE            RELOCATION
  312  A            REAL      ARRAY    BANARG          4  ACELR      REAL                //
    5  ACELZ        REAL               / /             2  B          REAL       ARRAY   BANARG
    0  C            REAL      ARRAY    ARG         30207  CODE       REAL       ARRAY   //
  100  COMM         REAL                              76  COSA       REAL
   73  DX           REAL                              74  DY         REAL
   23  E            REAL      ARRAY    / /           247  EE         REAL       ARRAY   ARG
  101  EP           REAL                              13  HED        REAL       ARRAY   / /
   71  I            INTEGER                        43767  IBC        INTEGER    ARRAY   / /
  256  IX           INTEGER   ARRAY    ARG            72  J          INTEGER
44443  JBC          INTEGER   ARRAY    / /           243  LM         INTEGER    ARRAY   ARG
    0  MBAND        INTEGER            BANARG         11  MTYPE      INTEGER            / /
    6  N            INTEGER            / /           637  NTC        INTEGER    ARRAY   / /
    1  NUMBLK       INTEGER            BANARG          1  NUMEL      INTEGER            / /
    2  NUMMAT       INTEGER            / /             0  NUMNP      INTEGER            / /
    3  NUMPC        INTEGER            / /           163  P          REAL       ARRAY   ARG
45117  PR           REAL      ARRAY    / /            12  Q          REAL               / /
  647  R            REAL      ARRAY    / /           623  RO         REAL       ARRAY   / /
  231  RR           REAL      ARRAY    ARG            11  S          REAL       ARRAY   ARG
  155  SIG          REAL      ARRAY    ARG            77  SINA       REAL
  173  ST           REAL      ARRAY    ARG         36077  T          REAL       ARRAY   / /
   10  TEMP         REAL               / /         14427  UR         REAL       ARRAY   / /
22317  UZ           REAL      ARRAY    / /             7  VOL        REAL               / /
35506  XC           REAL               ARG            75  XL         REAL
35507  YC           REAL               ARG          6537  Z          REAL       ARRAY   / /
  236  ZZ           REAL      ARRAY    ARG

EXTERNALS              TYPE    ARGS
       SQRT            REAL     1 LIBRARY

STATEMENT LABELS
    0  100

COMMON BLOCKS    LENGTH
       / /       19623
       ARG       15176
       BANARG    20202

STATISTICS
  PROGRAM LENGTH      102B        66
   COMMON LENGTH  105062B      35378
    BLANK COMMON   46247B      19623
```

```
      SUBROUTINE QUAD                                                   QUAD
      COMMON NUMNP,NUMEL,NUMMAT,NUMPC,ACELR,ACELZ,N,VOL,TEMP,MTYPE,Q,   QUAD
     1 HED(8),E(8,4,12),RO(12),NTC(8),R(3000),Z(3000),UR(3000),UZ(3000),
     2 CODE(3000),T(3000),IBC(300),JBC(300),PR(300,2)
      COMMON/ARG/C(3,3),S(10,10),SIG(6),P(8),ST(3,10),RR(5),ZZ(5),LM(4),
     1             EE(7),IX(3000,5),XC,YC
      COMMON/ORTHO/NORTHO(12),ANGLE(12),TH(12),S1(12),S2(12),S3(12),
     1                 S4(12),S5(12),S6(12),S7(12),S8(12),E11(12,8),
     2                 E22(12,8),G12(12,8),AMU12(12,8),A1(12,8),A2(12,8),
     3                 A12(12,8),TMAT(12,8)
      COMMON/BANARG/MBAND,NUMBLK,B(200),A(200,100)
      DIMENSION U(3),V(3)                                               QUAD
      I=IX(N,1)                                                         QUAD
      J=IX(N,2)                                                         QUAD
      K=IX(N,3)                                                         QUAD
      L=IX(N,4)                                                         QUAD
      MTYPE=IX(N,5)                                                     QUAD
      VOL=0.                                                            QUAD
      TEMP=(T(I)+T(J)+T(K)+T(L))/4.0                                    QUAD
      RATIO=0.0                                                         QUAD
      NUMTC=NTC(MTYPE)                                                  QUAD
      NXN=NORTHO(MTYPE)
      IF(NXN.GT.0) GO TO 111
      IF (NUMTC.EQ.1) GO TO 100                                         QUAD
      DO 50 M=2,NUMTC                                                   QUAD
      IF (E(M,1,MTYPE)-TEMP) 50,60,60                                   QUAD
   50 CONTINUE                                                          QUAD
   60 DEN=E(M,1,MTYPE)-E(M-1,1,MTYPE)                                   QUAD
      IF(DEN) 70,80,70                                                  QUAD
   70 RATIO=(TEMP-E(M-1,1,MTYPE))/DEN                                   QUAD
   80 DO 90 KK=1,3                                                      QUAD
   90 EE(KK)=E(M-1,KK+1,MTYPE)+RATIO*(E(M,KK+1,MTYPE)-E(M-1,KK+1,MTYPE))QUAD
      GO TO 110                                                         QUAD
  100 DO 105 KK=1,3                                                     QUAD
  105 EE(KK)=E(1,KK+1,MTYPE)                                            QUAD
  110 COMM=EE(1)/(1.-EE(2)**2)                                          QUAD
      GO TO 112
  111 CALL ELCON(MTYPE,NUMTC,TEMP)
      GO TO 113
  112 C(1,1)=COMM                                                       QUAD
      C(1,2)=COMM*EE(2)                                                 QUAD
      C(1,3)=0.                                                         QUAD
      C(2,1)=C(1,2)                                                     QUAD
      C(2,2)=C(1,1)                                                     QUAD
      C(2,3)=0.                                                         QUAD
      C(3,1)=0.                                                         QUAD
      C(3,2)=0.                                                         QUAD
      C(3,3)=.5*COMM*(1.-EE(2))                                         QUAD
  113 CONTINUE
  114 CONTINUE
      DO 130 J=1,10                                                     QUAD
      DO 120 I=1,3                                                      QUAD
  120 ST(I,J)=0.                                                        QUAD
      DO 130 I=1,10                                                     QUAD
  130 S(I,J)=0.                                                         QUAD
```

```
      DO 140 I=1,4                                                      QUAD
      NPP=IX(N,I)                                                       QUAD
      RR(I)=R(NPP)                                                      QUAD
  140 ZZ(I)=Z(NPP)                                                      QUAD
      IF(IX(N,3)-IX(N,4)) 145,150,145                                   QUAD
  145 XC=(RR(1)+RR(2)+RR(3)+RR(4))/4.                                   QUAD
      YC=(ZZ(1)+ZZ(2)+ZZ(3)+ZZ(4))/4.                                   QUAD
      RR(5)=XC                                                          QUAD
      ZZ(5)=YC                                                          QUAD
      K=5                                                               QUAD
      J=1                                                               QUAD
      I=4                                                               QUAD
      LM(3)=9                                                           QUAD
      NT=4                                                              QUAD
      GO TO 160                                                         QUAD
  150 NT=1                                                              QUAD
      LM(3)=5                                                           QUAD
      I=1                                                               QUAD
      K=3                                                               QUAD
      J=2                                                               QUAD
      XC=(RR(1)+RR(2)+RR(3))/3.                                         QUAD
      YC=(ZZ(1)+ZZ(2)+ZZ(3))/3.                                         QUAD
      RR(5)=RR(3)                                                       QUAD
      ZZ(5)=ZZ(3)                                                       QUAD
  160 DO 200 NN=1,NT                                                    QUAD
      LM(1)=2*I-1                                                       QUAD
      LM(2)=2*J-1                                                       QUAD
      U(1)=ZZ(J)-ZZ(K)                                                  QUAD
      U(2)=ZZ(K)-ZZ(I)                                                  QUAD
      U(3)=ZZ(I)-ZZ(J)                                                  QUAD
      V(1)=RR(K)-RR(J)                                                  QUAD
      V(2)=RR(I)-RR(K)                                                  QUAD
      V(3)=RR(J)-RR(I)                                                  QUAD
      AREA=(RR(J)*U(2)+RR(I)*U(1)+RR(5)*U(3))/2.                        QUAD
      VOL=VOL+AREA                                                      QUAD
      COMM=.25/AREA                                                     QUAD
      XNT=NT                                                            QUAD
      COM=2./XNT                                                        QUAD
      COM=COM*COMM                                                      QUAD
      DO 180 L=1,3                                                      QUAD
      II=LM(L)                                                          QUAD
      ST(1,II)=ST(1,II)+U(L)*COM                                        QUAD
      ST(2,II+1)=ST(2,II+1)+V(L)*COM                                    QUAD
      ST(3,II)=ST(3,II)+V(L)*COM                                        QUAD
      ST(3,II+1)=ST(3,II+1)+U(L)*COM                                    QUAD
      DO 180 M=1,3                                                      QUAD
      JJ=LM(M)                                                          QUAD
      S(II,JJ)=S(II,JJ)+(U(L)*C(1,1)*U(M)+V(L)*C(3,3)*V(M))*COMM        QUAD
      S(II,JJ+1)=S(II,JJ+1)+(U(L)*C(1,2)*V(M)+V(L)*C(3,3)*U(M))*COMM    QUAD
      S(II+1,JJ+1)=S(II+1,JJ+1)+(V(L)*C(1,1)*V(M)+U(L)*C(3,3)*U(M))*COMMQUAD
      S(JJ+1,II)=S(II,JJ+1)                                             QUAD
  180 CONTINUE                                                          QUAD
      I=J                                                               QUAD
      J=J+1                                                             QUAD
  200 CONTINUE                                                          QUAD
```

```
      IF(IX(N,3)-IX(N,4)) 220,250,220                                   QUAD
  220 DO 240 I=1,2                                                      QUAD
      KK=10-I                                                           QUAD
      DO 240 K=1,KK                                                     QUAD
      CC=S(KK+1,K)/S(KK+1,KK+1)                                         QUAD
      DO 230 J=1,3                                                      QUAD
  230 ST(J,K)=ST(J,K)-CC*ST(J,KK+1)                                     QUAD
      DO 240 J=1,KK                                                     QUAD
  240 S(J,K)=S(J,K)-CC*S(J,KK+1)                                        QUAD
  250 CONTINUE                                                          QUAD
      DT=TEMP-Q                                                         QUAD
      IF(NXN.GT.0) GO TO 260
      DX=EE(3)*DT                                                       QUAD
      DY=EE(3)*DT                                                       QUAD
      GO TO 261
  260 DX=(EE(5)*((COS(TH(M)))**2)-EE(6)*((SIN(TH(M)))**2))*DT
      DY=(EE(5)*((SIN(TH(M)))**2)-EE(6)*((COS(TH(M)))**2))*DT
  261 SIG(1)=-C(1,1)*DX-C(1,2)*DY                                       QUAD
      SIG(2)=-C(2,1)*DX-C(2,2)*DY                                       QUAD
      SIG(3)=0.                                                         QUAD
      DO 520 I=1,8                                                      QUAD
      P(I)=0.0                                                          QUAD
      DO 510 J=1,3                                                      QUAD
  510 P(I)=P(I)-ST(J,I)*SIG(J)                                          QUAD
  520 P(I)=P(I)*VOL                                                     QUAD
      MM=4                                                              QUAD
      IF(IX(N,3).EQ.IX(N,4)) MM=3                                       QUAD
      XMM=MM                                                            QUAD
      DY=VOL*ACELZ*RO(MTYPE)/XMM                                        QUAD
      DX=VOL*ACELR*RO(MTYPE)/XMM                                        QUAD
      DO 530 I=1,MM                                                     QUAD
      P(2*I)=P(2*I)+DY                                                  QUAD
  530 P(2*I-1)=P(2*I-1)+DX                                              QUAD
      RETURN                                                            QUAD
      END                                                               QUAD
```

```
     SYMBOLIC REFERENCE MAP

ENTRY POINTS
     1  QUAD

VARIABLES       SN  TYPE             RELOCATION
   312  A            REAL       ARRAY    BANARG            4  ACELR     REAL                / /
     5  ACELZ        REAL                / /             644  AMU12     REAL        ARRAY   ORTHO
    14  ANGLE        REAL       ARRAY    ORTHO           512  AREA      REAL
  1004  A1           REAL       ARRAY    ORTHO          1304  A12       REAL        ARRAY   ORTHO
  1144  A2           REAL       ARRAY    ORTHO             2  B         REAL        ARRAY   BANARG
     3  C            REAL       ARRAY    ARG             517  CC        REAL
 30207  CODE         REAL       ARRAY    / /             514  COM       REAL
   506  COMM         REAL                                504  DEN       REAL
   520  DT           REAL                                521  DX        REAL
   522  DY           REAL                                 23  E         REAL        ARRAY   / /
   247  EE           REAL       ARRAY    ARG             204  E11       REAL        ARRAY   ORTHO
   344  E22          REAL       ARRAY    ORTHO           504  G12       REAL        ARRAY   ORTHO
    13  HED          REAL       ARRAY    / /             474  I         INTEGER
 43767  IBC          INTEGER    ARRAY    / /             515  II        INTEGER
   256  IX           INTEGER    ARRAY    ARG             475  J         INTEGER
 44443  JBC          INTEGER    ARRAY    / /             516  JJ        INTEGER
   476  K            INTEGER                             505  KK        INTEGER
   477  L            INTEGER                             243  LM        INTEGER     ARRAY   ARG
   503  M            INTEGER                               0  MBAND     INTEGER             BANARG
   523  MM           INTEGER                              11  MTYPE     INTEGER             / /
     6  N            INTEGER             / /             511  NN        INTEGER
     0  NORTHO       INTEGER    ARRAY    ORTHO           507  NPP       INTEGER
   510  NT           INTEGER                             637  NTC       INTEGER     ARRAY   / /
     1  NUMBLK       INTEGER             BANARG            1  NUMEL     INTEGER             / /
     2  NUMMAT       INTEGER             / /               0  NUMNP     INTEGER             / /
     3  NUMPC        INTEGER             / /             501  NUMTC     INTEGER
   502  NXN          INTEGER                             163  P         REAL        ARRAY   ARG
 45117  PR           REAL       ARRAY    / /              12  Q         REAL                / /
   647  R            REAL       ARRAY    / /             500  RATIO     REAL
   623  RO           REAL       ARRAY    / /             231  RR        REAL        ARRAY   ARG
    11  S            REAL       ARRAY    ARG             155  SIG       REAL        ARRAY   ARG
   173  ST           REAL       ARRAY    ARG              44  S1        REAL        ARRAY   ORTHO
    60  S2           REAL       ARRAY    ORTHO            74  S3        REAL        ARRAY   ORTHO
   110  S4           REAL       ARRAY    ORTHO           124  S5        REAL        ARRAY   ORTHO
   140  S6           REAL       ARRAY    ORTHO           154  S7        REAL        ARRAY   ORTHO
   170  S8           REAL       ARRAY    ORTHO         36077  T         REAL        ARRAY   / /
    10  TEMP         REAL                / /              30  TH        REAL        ARRAY   ORTHO
  1444  THAT         REAL       ARRAY    ORTHO           525  U         REAL        ARRAY
 14427  UR           REAL       ARRAY    / /           22317  UZ        REAL        ARRAY   / /
   530  V            REAL       ARRAY                      7  VOL       REAL                / /
 35506  XC           REAL                ARG             524  XMM       REAL
   513  XNT          REAL                              35507  YC        REAL                ARG
  6537  Z            REAL       ARRAY    / /             236  ZZ        REAL        ARRAY   ARG

EXTERNALS        TYPE   ARGS
     COS         REAL     1 LIBRARY                          ALOGN               3
     SIN         REAL     1 LIBRARY
```

```
      SUBROUTINE  QUAD                                    CDC 6600 FTN /3.0-320A OPT=1  02/02/73  17.05.44.        PAGE     5

STATEMENT LABELS
     0   50                                 37   60                                  0   70          INACTIVE
    50   80                                  0   90                                 61  100
     0  105                                 67  110                                 73  111
    76  112                                110  113                                  0  114          INACTIVE
     0  120                                  0  130                                  0  140
     0  145            INACTIVE            161  150                                176  160
     0  180                                  0  200                                  0  220          INACTIVE
     0  230                                  0  240                                363  250
   372  260                                412  261                                  0  510
     0  520                                  0  530

COMMON BLOCKS   LENGTH
      / /        19623
      ARG        15176
      ORTHO        900
      UANARG     20202

STATISTICS
  PROGRAM LENGTH     533B       347
   COMMON LENGTH  106666B     36278
    BLANK COMMON   46247B     19623
```

```
      SUBROUTINE STRESS(NPRT)
      COMMON NUMNP,NUMEL,NUMMAT,NUMPC,ACELR,ACELZ,N,VOL,TEMP,MTYPE,Q,    STRS
     1 HED(8),E(8,4,12),RO(12),NTC(8),R(3000),Z(3000),UR(3000),UZ(3000),
     2 CODE(3000),T(3000),IBC(300),JBC(300),PR(300,2)
      COMMON/ARG/C(3,3),S(10,10),SIG(6),P(8),ST(3,10),RR(5),ZZ(5),LM(4),
     1              EE(7),IX(3000,5),XC,YC
      COMMON/BANARG/MBAND,NUMBLK,B(200),A(200,100)
      MPRINT=0                                                          STRS
      DO 300 M=1,NUMEL                                                  STRS
      N=M                                                               STRS
      IX(N,5)=IABS(IX(N,5))                                             STRS
      MTYPE=IX(N,5)                                                     STRS
      DO 50 I=1,6
   50 SIG(I)=0.0
      IF(IX(N,3)-IX(N,2)) 90,60,90
   60 I=IX(N,1)
      J=IX(N,2)
      XC=(R(I)+R(J))/2.0
      YC=(Z(I)+Z(J))/2.0
      DX=R(J)-R(I)
      DY=Z(J)-Z(I)
      XL=SQRT(DX**2+DY**2)
      DU=B(2*J-1)-B(2*I-1)
      DV=B(2*J)-B(2*I)
      DL=DV*DY/XL+DU*DX/XL
      SIG(4)=E(1,4,MTYPE)*DL*E(1,2,MTYPE)/XL
      GO TO 200
   90 CALL QUAD
      MM=4                                                              STRS
      IF(IX(N,3)-IX(N,4)) 170,160,170                                   STRS
  160 MM=3                                                              STRS
  170 DO 180 I=1,3                                                      STRS
      RR(I)=0.                                                          STRS
      DO 180 J=1,MM                                                     STRS
      II=2*J                                                            STRS
      JJ=2*IX(N,J)                                                      STRS
  180 RR(I)=RR(I)+ST(I,II)*B(JJ)+ST(I,II-1)*B(JJ-1)                     STRS
      DO 190 I=1,3                                                      STRS
      DO 190 J=1,3                                                      STRS
  190 SIG(I)=SIG(I)+C(I,J)*RR(J)                                        STRS
      CC=(SIG(1)+SIG(2))/2.0                                            STRS
      BB=(SIG(1)-SIG(2))/2.                                             STRS
      CR=SQRT(BB**2+SIG(3)**2)
      SIG(4)=CC+CR                                                      STRS
      SIG(5)=CC-CR                                                      STRS
      SIG(6)=0.0                                                        STRS
      IF ((BB.EQ.0.0).AND.(SIG(3).EQ.0.0)) GO TO 200                    STRS
      SIG(6)=28.64*ATAN2(SIG(3),BB)
      IF(NPRT.EQ.1) GO TO 270
  200 IF(MPRINT)  250,220,250                                           STRS
  220 WRITE(6,2000)                                                     STRS
      MPRINT=50                                                         STRS
  250 MPRINT=MPRINT-1                                                   STRS
      WRITE (6,2001)  N,XC,YC,(SIG(I),I=1,6)                            STRS
      GO TO 300
```

```
  270 IF(MPRINT) 280,290,280
  290 WRITE(6,2003)
      MPRINT=50
  280 MPRINT=MPRINT-1
      WRITE(6,2004) N,XC,YC,(SIG(I),I=1,3),(RR(I),I=1, 3)
  300 CONTINUE                                                    STRS
      RETURN                                                      STRS
 2000 FORMAT (7H1EL.NO.  7X 1HX  7X 1HY 4X 8HX-STRESS 4X 8HY-STRESS 3X  STRS
     1 9HXY-STRESS 2X 10HMAX-STRESS 2X 10HMIN-STRESS 7H  ANGLE )   STRS
 2001 FORMAT (I7,2F8.4,1P5E12.4,0P1F7.2)
 2002 FORMAT (I5,4F10.5)
 2003 FORMAT (7H1EL.NO. ,7X,1HX,7X,1HY,4X,8HX-STRESS,4X,8HY-STRESS,3X,
     1 9HXY-STRESS,2X,10H X-STRAIN ,2X,10H Y-STRAIN ,2X,10H XY-STRAIN)
 2004 FORMAT (I7,2F8.4,1P6E12.4)
      END                                                         STRS
```

```
SYMBOLIC REFERENCE MAP

ENTRY POINTS
    2  STRESS

VARIABLES      SN  TYPE             RELOCATION
    312  A         REAL       ARRAY   BANARG          4  ACELR     REAL               / /
      5  ACELZ     REAL               / /             2  B         REAL      ARRAY    BANARG
    314  BB        REAL                               0  C         REAL      ARRAY    ARG
    313  CC        REAL                           30207  CODE      REAL      ARRAY    / /
    315  CR        REAL                             307  DL        REAL
    305  DU        REAL                             306  DV        REAL
    302  DX        REAL                             303  DY        REAL
     23  E         REAL       ARRAY   / /           247  EE        REAL      ARRAY    ARG
     13  HED       REAL       ARRAY   / /           300  I         INTEGER
  43767  IBC       INTEGER    ARRAY   / /           311  II        INTEGER
    256  IX        INTEGER    ARRAY   ARG           301  J         INTEGER
  44443  JBC       INTEGER    ARRAY   / /           312  JJ        INTEGER
    243  LM        INTEGER    ARRAY   ARG           277  M         INTEGER
      0  MBAND     INTEGER            BANARG        310  MM        INTEGER
    276  MPRINT    INTEGER                           11  MTYPE     INTEGER            / /
      6  N         INTEGER            / /             0  NPRT      INTEGER            F.P.
    637  NTC       INTEGER    ARRAY   / /             1  NUMBLK    INTEGER            BANARG
      1  NUMEL     INTEGER            / /             2  NUMMAT    INTEGER            / /
      0  NUMNP     INTEGER            / /             3  NUMPC     INTEGER            / /
    163  P         REAL       ARRAY   ARG         45117  PR        REAL      ARRAY    / /
     12  Q         REAL               / /           647  R         REAL      ARRAY    / /
    623  RO        REAL       ARRAY   / /           231  RR        REAL      ARRAY    ARG
     11  S         REAL       ARRAY   ARG           155  SIG       REAL      ARRAY    ARG
    173  ST        REAL       ARRAY   ARG         36077  T         REAL      ARRAY    / /
     10  TEMP      REAL               / /         14427  UR        REAL      ARRAY    / /
  22317  UZ        REAL       ARRAY   / /             7  VOL       REAL               / /
  35506  XC        REAL               ARG           304  XL        REAL
  35507  YC        REAL               ARG          6537  Z         REAL      ARRAY    / /
    236  ZZ        REAL       ARRAY   ARG

FILE NAMES       MODE
    TAPE6         FMT

EXTERNALS        TYPE   ARGS
    ATAN2        REAL     2 LIBRARY                      QUAD              0
    SQRT         REAL     1 LIBRARY

INLINE FUNCTIONS  TYPE   ARGS
    IABS         INTEGER  1  INTRIN

STATEMENT LABELS
      0  50                                0  60      INACTIVE           63   90
      0  160       INACTIVE               72  170                         0  180
      0  190                             157  200                         0  220       INACTIVE
    164  250                             202  270                       207  280
      0  290       INACTIVE              226  300                       232  2000   FMT
    245  2001    FMT                     251  2002  FMT  NO REFS        254  2003   FMT
    270  2004    FMT
```

```
COMMON BLOCKS   LENGTH
    / /          19623
    ARG          15176
    BANARG       20202

STATISTICS
  PROGRAM LENGTH     320B       208
   COMMON LENGTH  105062B     35378
    BLANK COMMON   46247B     19623
```

```
      SUBROUTINE MODIFY(A,B,NEQ,MBAND,N,U)                            MODI
      DIMENSION A(200,100),B(200)
      DO 250 M=2,MBAND                                                MODI
      K=N-M+1                                                         MODI
      IF(K) 235,235,230                                               MODI
  230 B(K)=B(K)-A(K,M)*U                                              MODI
      A(K,M)=0.0                                                      MODI
  235 K=N+M-1                                                         MODI
      IF(NEQ-K) 250,240,240                                           MODI
  240 B(K)=B(K)-A(N,M)*U                                              MODI
      A(N,M)=0.0                                                      MODI
  250 CONTINUE                                                        MODI
      A(N,1)=1.0                                                      MODI
      B(N)=U                                                          MODI
      RETURN                                                          MODI
      END                                                             MODI
```

```
SUBROUTINE  MODIFY                                          CDC 6600 FTN V3.0-320A OPT=1  02/02/73  17.05.44.      PAGE    2

            SYMBOLIC REFERENCE MAP

ENTRY POINTS
     2  MODIFY

VARIABLES       SN  TYPE              RELOCATION
     0  A            REAL         ARRAY     F.P.          0   B          REAL        ARRAY     F.P.
    55  K            INTEGER                              54  M          INTEGER
     0  M3AND        INTEGER                F.P.          0   N          INTEGER               F.P.
     0  NEQ          INTEGER                F.P.          0   U          REAL                  F.P.

STATEMENT LABELS
     0  230          INACTIVE               34  235                                       0  240          INACTIVE
    43  250

STATISTICS
  PROGRAM LENGTH       773      63
```

```
      SUBROUTINE BANSOL                                          BANS
      COMMON/BANARG/MBAND,NUMBLK,B(200),A(200,100)
      MM=MBAND
      NN=100                                                     BANS
      NL=NN+1                                                    BANS
      NH=NN+NN                                                   BANS
      REWIND 1                                                   BANS
      REWIND 2                                                   BANS
      NB=0                                                       BANS
      GO TO 150                                                  BANS
  100 NB=NB+1                                                    BANS
      DO 125 N=1,NN                                              BANS
      NM=NN+N                                                    BANS
      B(N)=B(NM)                                                 BANS
      B(NM)=0.0                                                  BANS
      DO 125 M=1,MM                                              BANS
      A(N,M)=A(NM,M)                                             BANS
  125 A(NM,M)=0.0                                                BANS
      IF (NUMBLK-NB) 150,200,150                                 BANS
  150 READ (2) (B(N),(A(N,M),M=1,MM),N=NL,NH)                    BANS
      IF (NB) 200,100,200                                        BANS
  200 DO 300 N=1,NN                                              BANS
      IF (A(N,1)) 225,300,225                                    BANS
  225 B(N)=B(N)/A(N,1)                                           BANS
      DO 275 L=2,MM                                              BANS
      IF (A(N,L)) 230,275,230                                    BANS
  230 C=A(N,L)/A(N,1)                                            BANS
      I=N+L-1                                                    BANS
      J=0                                                        BANS
      DO 250 K=L,MM                                              BANS
      J=J+1                                                      BANS
  250 A(I,J)=A(I,J)-C*A(N,K)                                     BANS
      B(I)=B(I)-A(N,L)*B(N)                                      BANS
      A(N,L)=C                                                   BANS
  275 CONTINUE                                                   BANS
  300 CONTINUE                                                   BANS
      IF (NUMBLK-NB) 375,400,375                                 BANS
  375 WRITE (1) (B(N),(A(N,M),M=2,MM),N=1,NN)                    BANS
      GO TO 100                                                  BANS
  400 DO 450 M=1,NN                                              BANS
      N=NN+1-M                                                   BANS
      DO 425 K=2,MM                                              BANS
      L=N+K-1                                                    BANS
  425 B(N)=B(N)-A(N,K)*B(L)                                      BANS
      NM=N+NN                                                    BANS
      B(NM)=B(N)                                                 BANS
  450 A(NM,NB)=B(N)                                              BANS
      NB=NB-1                                                    BANS
      IF (NB) 475,500,475                                        BANS
  475 BACKSPACE 1                                                BANS
      READ (1) (B(N),(A(N,M),M=2,MM),N=1,NN)                     BANS
      BACKSPACE 1                                                BANS
      GO TO 400                                                  BANS
  500 K=0                                                        BANS
      DO 600 NB=1,NUMBLK                                         BANS
```

```
      DO 600 N=1,NN                                                 BANS
      NM=N+NN                                                       BANS
      K=K+1                                                         BANS
  600 B(K)=A(NM,NB)                                                 BANS
      RETURN                                                        BANS
      END                                                           BANS
```

```
    SYMBOLIC REFERENCE MAP

ENTRY POINTS
    1  BANSOL

VARIABLES      SN  TYPE          RELOCATION
  312  A           REAL      ARRAY   BANARG          2  B        REAL       ARRAY   BANARG
  262  C           REAL                            263  I        INTEGER
  264  J           INTEGER                         265  K        INTEGER
  261  L           INTEGER                         260  M        INTEGER
    0  MBAND       INTEGER           BANARG        251  MM       INTEGER
  256  N           INTEGER                         255  NB       INTEGER
  254  NH          INTEGER                         253  NL       INTEGER
  257  NM          INTEGER                         252  NN       INTEGER
    1  NUMBLK      INTEGER           BANARG

FILE NAMES        MODE
   TAPE1          UNFMT              TAPE2    UNFMT

STATEMENT LABELS
   14  100                            0  125                          37  150
   61  200                            0  225      INACTIVE             0  230      INACTIVE
    0  250                          122  275                         125  300
    0  375         INACTIVE         152  400                           0  425
    0  450                            0  475      INACTIVE           230  500
    0  600

COMMON BLOCKS   LENGTH
    BANARG      20202

STATISTICS
  PROGRAM LENGTH     2668      182
   COMMON LENGTH   473528    20202
```

```
      SUBROUTINE ORTHOG(M,NUMTC)
C
      COMMON/ORTHO/NORTHO(12),ANGLE(12),TH(12),S1(12),S2(12),S3(12),
     1            S4(12),S5(12),S6(12),S7(12),S8(12),E11(12,8),
     2            E22(12,8),G12(12,8),AMU12(12,8),A1(12,8),A2(12,8),
     3            A12(12,8),TMAT(12,8)
C
      READ (5,1001) ANGLE(M)
      WRITE(6,2001) ANGLE(M)
      DO 1 I=1,NUMTC
      READ (5,1000) (TMAT(M,I),E11(M,I),E22(M,I),G12(M,I),AMU12(M,I),
     1              A1(M,I),A2(M,I),A12(M,I))
      WRITE(6,2000) (TMAT(M,I),E11(M,I),E22(M,I),G12(M,I),AMU12(M,I),
     1              A1(M,I),A2(M,I),A12(M,I))
    1 CONTINUE
      TH(M)=ANGLE(M)*3.1415926536/180.
      D=SIN(TH(M))
      F=COS(TH(M))
      S1(M)=F**4
      S2(M)=F**2*D**2
      S3(M)=F**3*D
      S4(M)=D**4
      S5(M)=F*D**3
      S6(M)=F**2
      S7(M)=D**2
      S8(M)=F*D
 1000 FORMAT (8F10.0)
 1001 FORMAT (F10.0)
 2000 FORMAT (3X,*TEMPERATURE*,7X,*E11*,12X,*E22*,12X,*G12*,11X,*AMU12*,
     1       9X,*ALPHA 1*,8X,*ALPHA 2*,8X,*ALPHA12*/8F15.4)
 2001 FORMAT (5X,*ANGLE= *,F5.2)
      RETURN
      END
```

```
      SYMBOLIC REFERENCE MAP

ENTRY POINTS
    2  ORTHOG

VARIABLES     SN  TYPE             RELOCATION
   644  AMU12      REAL      ARRAY    ORTHO          14  ANGLE      REAL       ARRAY   ORTHO
  1004  A1         REAL      ARRAY    ORTHO        1304  A12        REAL       ARRAY   ORTHO
  1144  A2         REAL      ARRAY    ORTHO         206  D          REAL
   234  E11        REAL      ARRAY    ORTHO         344  E22        REAL       ARRAY   ORTHO
   207  F          REAL                             504  G12        REAL       ARRAY   ORTHO
   205  I          INTEGER                            0  M          INTEGER              F.P.
     0  NORTHO     INTEGER   ARRAY    ORTHO           0  NUMTC      INTEGER              F.P.
    44  S1         REAL      ARRAY    ORTHO          60  S2         REAL       ARRAY   ORTHO
    74  S3         REAL      ARRAY    ORTHO         110  S4         REAL       ARRAY   ORTHO
   124  S5         REAL      ARRAY    ORTHO         140  S6         REAL       ARRAY   ORTHO
   154  S7         REAL      ARRAY    ORTHO         170  S8         REAL       ARRAY   ORTHO
    30  TH         REAL      ARRAY    ORTHO        1444  TMAT       REAL       ARRAY   ORTHO

FILE NAMES        MODE
      TAPE5       FMT              TAPE6       FMT

EXTERNALS         TYPE   ARGS
      COS         REAL     1 LIBRARY                      SIN       REAL       1 LIBRARY

STATEMENT LABELS
      0  1                                161  1000    FMT                              163  1001    FMT
    165  2000     FMT                     177  2001    FMT

COMMON BLOCKS   LENGTH
      ORTHO       900

STATISTICS
  PROGRAM LENGTH     233B      155
   COMMON LENGTH    1604B      900
```

```
      SUBROUTINE ELCON(M,NUMTC,TEMP)
C
      COMMON/ARG/C(3,3),S(10,10),SIG(6),P(8),ST(3,10),RR(5),ZZ(5),LM(4),
     1          EE(7),IX(3000,5),XC,YC
      COMMON/ORTHO/NORTHO(12),ANGLE(12),TH(12),S1(12),S2(12),S3(12),
     1             S4(12),S5(12),S6(12),S7(12),S8(12),E11(12,8),
     2             E22(12,8),G12(12,8),AMU12(12,8),A1(12,8),A2(12,8),
     3             A12(12,8),TMAT(12,8)
C
      RATIO=0.0
      IF(NUMTC.EQ.1) GO TO 100
      DO 1 I=2,NUMTC
      J=I-1
      SRT=TMAT(M,I)-TEMP
      IF(SRT.GE.0.0) GO TO 2
    1 CONTINUE
    2 DEN=TMAT(M,I)-TMAT(M,J)
      IF(DEN.EQ.0.0) GO TO 3
      RATIO=(TEMP-TMAT(M,J))/DEN
    3 EE(1)=E11(M,J)+RATIO*(E11(M,I)-E11(M,J))
      EE(2)=E22(M,J)+RATIO*(E22(M,I)-E22(M,J))
      EE(3)=G12(M,J)+RATIO*(G12(M,I)-G12(M,J))
      EE(4)=AMU12(M,J)+RATIO*(AMU12(M,I)-AMU12(M,J))
      AX=A1(M,I)-A1(M,J)
      AY=A2(M,I)-A2(M,J)
      AZ=A12(M,I)-A12(M,J)
      EE(5)=A1(M,J)+RATIO*AX
      EE(6)=A2(M,J)+RATIO*AY
      EE(7)=A12(M,J)+RATIO*AZ
      EE(5)=0.5*(EE(5)+A1(M,1))
      EE(6)=0.5*(EE(6)+A2(M,1))
      EE(7)=0.5*(EE(7)+A12(M,1))
      GO TO 110
  100 EE(1)=E11(M,1)
      EE(2)=E22(M,1)
      EE(3)=G12(M,1)
      EE(4)=AMU12(M,1)
      EE(5)=A1(M,1)
      EE(6)=A2(M,1)
      EE(7)=A12(M,1)
  110 UN=EE(4)*EE(2)/EE(1)
      UNU=1./(1.-UN*EE(4))
      C11=EE(1)*UNU
      C12=EE(2)*EE(4)*UNU
      C16=0.0
      C22=EE(2)*UNU
      C26=0.0
      C66=EE(3)*UNU
      C21=C12
      C61=C16
      C62=C26
      C(1,1)=S1(M)*C11+2.*S2(M)*C12+4.*S3(M)*C16+S4(M)*C22+4.*S5(M)*C26+
     1       4.*S2(M)*C66
      C(1,2)=S2(M)*C11+(S1(M)+S4(M))*C12+2.*(S5(M)-S3(M))*C16+S2(M)*C22+
     1       2.*(S3(M)-S5(M))*C26-4.*S2(M)*C66
```

```
      C(2,1)=C(1,2)
      C(1,3)=-S3(M)*C11+(S3(M)-S5(M))*C12+(S1(M)-3.*S2(M))*C16+S5(M)*C22
     1        +(3.*S2(M)-S4(M))*C26+2.*(S3(M)-S5(M))*C66
      C(3,1)=C(1,3)
      C(2,2)=S4(M)*C11+2.*S2(M)*C12-4.*S5(M)*C16+S1(M)*C22-4.*S3(M)*C26+
     1        4.*S2(M)*C66
      C(2,3)=-S5(M)*C11+(S5(M)-S3(M))*C12+(3.*S2(M)-S4(M))*C16+S3(M)*C22
     1        +(S1(M)-3.*S2(M))*C26+(S5(M)-S3(M))*2.*C66
      C(3,2)=C(2,3)
      C(3,3)=S2(M)*C11-2.*S2(M)*C12+2.*(S5(M)-S3(M))*C16+S2(M)*C22+
     1        2.*(S3(M)-S5(M))*C26+(S6(M)-S7(M))**2*C66
      RETURN
      END
```

```
SYMBOLIC REFERENCE MAP

ENTRY POINTS
    2  ELCON

VARIABLES      SN  TYPE           RELOCATION
   644  A1U12       REAL       ARRAY    ORTHO          14  ANGLE    REAL      ARRAY    ORTHO
   355  AX          REAL                              356  AY       REAL
   357  AZ          REAL                             1004  A1       REAL      ARRAY    ORTHO
  1304  A12         REAL       ARRAY    ORTHO        1144  A2       REAL      ARRAY    ORTHO
     0  C           REAL       ARRAY    ARG           362  C11      REAL
   363  C12         REAL                              364  C16      REAL
   370  C21         REAL                              365  C22      REAL
   366  C26         REAL                              371  C61      REAL
   372  C62         REAL                              367  C66      REAL
   354  DEN         REAL                              247  EE       REAL      ARRAY    ARG
   204  E11         REAL       ARRAY    ORTHO         344  E22      REAL      ARRAY    ORTHO
   504  G12         REAL       ARRAY    ORTHO         351  I        INTEGER
   256  IX          INTEGER    ARRAY    ARG           352  J        INTEGER
   243  LM          INTEGER    ARRAY    ARG             0  M        INTEGER            F.P.
     0  NORTHO      INTEGER    ARRAY    ORTHO           0  NUMTC    INTEGER            F.P.
   163  P           REAL       ARRAY    ARG           350  RATIO    REAL
   231  RK          REAL       ARRAY    ARG            11  S        REAL      ARRAY    ARG
   155  SIG         REAL       ARRAY    ARG           353  SRT      REAL
   173  ST          REAL       ARRAY    ARG            44  S1       REAL      ARRAY    ORTHO
    60  S2          REAL       ARRAY    ORTHO          74  S3       REAL      ARRAY    ORTHO
   110  S4          REAL       ARRAY    ORTHO         124  S5       REAL      ARRAY    ORTHO
   140  S6          REAL       ARRAY    ORTHO         154  S7       REAL      ARRAY    ORTHO
   170  S8          REAL       ARRAY    ORTHO           0  TEMP     REAL               F.P.
    30  TH          REAL       ARRAY    ORTHO        1444  TMAT     REAL      ARRAY    ORTHO
   360  UH          REAL                              361  UNU      REAL
 35506  XC          REAL                ARG         35507  YC       REAL               ARG
   236  ZZ          REAL       ARRAY    ARG

STATEMENT LABELS
     0  1                                 26  2                           44  3
   156  100                              171  110

COMMON BLOCKS   LENGTH
        ARG     15176
        ORTHO     900

STATISTICS
  PROGRAM LENGTH     3733      251
   COMMON LENGTH   373140    16076
```

```
CORE MAP  17.06.45.  NORMAL              CONTROL                                                     000100    176112     127643     046247
          ---TIME---LOAD MODE --L1--L2-----TYPE---------------USER---++---CALL-------------FWA LOAD--LWA LOAD--BLNK COMN--LENGTH--
          FWA LOADER  172767  FWA TABLES  167565
          -PROGRAM----ADDRESS-                      --LABELED---COMMON--
          PLSTR       106766                                   ARG          000100
                                                               ORTHO        035610
                                                               BANARG       037414
          STIFF       115056                                   ARG          000100
                                                               BANARG       037414
          ONED        115516                                   ARG          000100
                                                               BANARG       037414
          QUAD        115620                                   ARG          000100
                                                               ORTHO        035610
                                                               BANARG       037414
          STRESS      116353                                   ARG          000100
                                                               BANARG       037414
          MODIFY      116673
          BANSOL      116772                                   BANARG       037414
          ORTHOG      117260                                   ORTHO        035610
          ELCON       117513                                   ARG          000100
                                                               ORTHO        035610
          BACKSP$     120106
          IFENDF$     120433
          INPUTB$     120512
          INPUTC$     120773
          KODER$      121127
          KRAKER$     122542
          OUTPTB$     124321
          OUTPTC$     124600
          REWINM$     124674
          ATAN2E      124746
          SINCOSE     125047
          SQRTE       125124
          GETBA       125146
          SIO$        125165
          SYSTEM$     126632
          ----UNSATISFIED EXTERNALS-----                          REFERENCES
```

APPENDIX C

SAMPLE PROBLEM INPUT AND OUTPUT

Take a grid consisting of 64 grid points and 49 elements (See Figure A-1). Assume a distributed load through grid points 1-8 such that the eight respective point loads are 500, 1000, 1000, 1000,1000,1000, 1000, and 500 pounds. Assume also that grid points 57-64 are constrained in the x-direction. A constant pressure of 100 psi is applied to the lower surface. The temperature throughout the grid is 70°F, while the stress-free temperature of the structure is 0°F. The structure consists of two materials as follows:

Material 1 (isotropic) exists from y = 0.0 to y = 0.32 and has as properties

	0°	70°
E	10^6 psi	9×10^5 psi
ν	0.3	0.3
α	5×10^{-6} in/in/°F	6×10^{-6} in/in/°F

Material 2 (orthotropic) exists from y = 0.32 to y = 0.8 at an angle of 0° in the xz-plane and has as properties

	0°	70°
E_{11}	10^6	9×10^5
E_{22}	10^5	9×10^4
G_{12}	10^5	9.5×10^4
ν_{12}	0.25	0.25
α_{11}	5×10^{-6}	6×10^{-6}
α_{22}	5×10^{-5}	6×10^{-5}
α_{12}	0.0	0.0

The input and output for this problem is as follows:

SAMPLE INPUT

LISTING OF THE INPUT FOR PLSTR SAMPLE PROBLEM

DATA CARD NUMBER ONE

```
     1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
12345678901234567890123456789012345678901234567890123456789012345678901234567890
      SAMPLE PROBLEM FOR PLSTR USER'S MANUAL. EXAMPLE FROM APPENDIX C.
```

DATA CARD NUMBER TWO

```
     1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
12345678901234567890123456789012345678901234567890123456789012345678901234567890
   64   49    2    7       0.0       0.0       0.0
```

DATA CARD NUMBER THREE

```
     1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
12345678901234567890123456789012345678901234567890123456789012345678901234567890
    1    2       0.1    0
```

DATA CARDS NUMBER FOUR

```
     1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
12345678901234567890123456789012345678901234567890123456789012345678901234567890
       0.0  1000000.            0.3  0.000005
      70.0   900000.            0.3  0.000006
```

DATA CARD NUMBER THREE

```
     1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
12345678901234567890123456789012345678901234567890123456789012345678901234567890
    2    2       0.1    1
```

DATA CARD NUMBER THREE-A

DATA CARDS NUMBER FOUR

```
      1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
12345678901234567890123456789012345678901234567890123456789012345678901234567890
       0.0  1000000.   100000.   100000.      0.25  0.000005   0.00005       0.0
      70.0   900000.    90000.    95000.      0.25  0.000006   0.00006       0.0
```

DATA CARDS NUMBER FIVE

1-10		11-20	21-30	31-40	41-50	51-60	61-70	71-80
1	0.0	0.0	0.0	500.	0.0	70.0		
2	0.0	0.08	0.08	1000.	0.0	70.0		
3	0.0	0.16	0.16	1000.	0.0	70.0		
4	0.0	0.24	0.24	1000.	0.0	70.0		
5	0.0	0.32	0.32	1000.	0.0	70.0		
6	0.0	0.4	0.4	1000.	0.0	70.0		
7	0.0	0.6	0.6	1000.	0.0	70.0		
8	0.0	0.8	0.8	500.	0.0	70.0		
9	0.0	0.4	0.0	0.0	0.0	70.0		
14	0.0	0.8	0.4	0.0	0.0	70.0		
16	0.0	1.2	0.8	0.0	0.0	70.0		
17	0.0	0.8	0.0	0.0	0.0	70.0		
22	0.0	1.2	0.4	0.0	0.0	70.0		
24	0.0	1.6	0.8	0.0	0.0	70.0		
25	0.0	1.6	0.0	0.0	0.0	70.0		
30	0.0	2.0	0.4	0.0	0.0	70.0		
32	0.0	2.4	0.8	0.0	0.0	70.0		
33	0.0	1.8	0.0	0.0	0.0	70.0		
38	0.0	2.2	0.4	0.0	0.0	70.0		
40	0.0	2.6	0.8	0.0	0.0	70.0		
41	0.0	2.2	0.0	0.0	0.0	70.0		
46	0.0	2.6	0.4	0.0	0.0	70.0		
48	0.0	3.0	0.8	0.0	0.0	70.0		
49	0.0	3.0	0.0	0.0	0.0	70.0		
54	0.0	3.4	0.4	0.0	0.0	70.0		
56	0.0	3.8	0.8	0.0	0.0	70.0		
57	1.0	3.4	0.0	0.0	0.0	70.0		
58	1.0	3.48	0.08	0.0	0.0	70.0		
59	1.0	3.56	0.16	0.0	0.0	70.0		
60	1.0	3.64	0.24	0.0	0.0	70.0		
61	1.0	3.72	0.32	0.0	0.0	70.0		
62	1.0	3.8	0.4	0.0	0.0	70.0		
63	1.0	4.0	0.6	0.0	0.0	70.0		
64	1.0	4.2	0.8	0.0	0.0	70.0		

DATA CARDS NUMBER SIX

```
    1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
1234567890123456789012345678901234567890123456789012345678901234567890123456789 0

    1    1    9   10    2    1
    4    4   12   13    5    1
    5    5   13   14    6    2
    7    7   15   16    8    2
    8    9   17   18   10    1
   11   12   20   21   13    1
   12   13   21   22   14    2
   14   15   23   24   16    2
   15   17   25   26   18    1
   18   20   28   29   20    1
   19   21   29   30   22    2
   21   23   31   32   24    2
   22   25   33   34   26    1
   25   28   36   37   29    1
   26   29   37   38   30    2
   28   31   39   40   32    2
   29   33   41   42   34    1
   32   36   44   45   37    1
   33   37   45   46   38    2
   35   39   47   48   40    2
   36   41   49   50   42    1
   39   44   52   53   45    1
   40   45   53   54   46    2
   42   47   55   56   48    2
   43   49   57   58   50    1
   46   52   60   61   53    1
   47   53   61   62   54    2
   49   55   63   64   56    2
```

DATA CARDS NUMBER SEVEN

```
    1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
12345678901234567890123456789012345678901234567890123456789012345678901234567890

       1       9      100.      100.
       9      17      100.      100.
      17      25      100.      100.
      25      33      100.      100.
      33      41      100.      100.
      41      49      100.      100.
      49      57      100.      100.
```

DATA CARD NUMBER EIGHT

```
    1-10      11-20     21-30     31-40     41-50     51-60     61-70     71-80
12345678901234567890123456789012345678901234567890123456789012345678901234567890

       1
```

SAMPLE OUTPUT

```
SAMPLE PROBLEM FOR PLSTR USER'S MANUAL. EXAMPLE FROM APPENDIX C.

NUMBER OF NODAL POINTS------   64

NUMBER OF ELEMENTS----------   49

NUMBER OF DIFF. MATERIALS---   2

NUMBER OF PRESSURE CARDS----   7

X-ACCELERATION--------------   0.

Y-ACCELERATION--------------   0.

REFERENCE TEMPERATURE-------   0.
MATERIAL NUMBER=   1, NUMBER OF TEMPERATURE CARDS=   2, MASS DENSITY=    .1000E+00, NORTHO=   0

 TEMPERATURE          E              NU             ALPHA
       0.00      .10000E+07     .30000E+00     .50000E-05
      70.00      .90000E+06     .30000E+00     .60000E-05
MATERIAL NUMBER=   2, NUMBER OF TEMPERATURE CARDS=   2, MASS DENSITY=    .1000E+00, NORTHO=   1
   ANGLE=  0.00
 TEMPERATURE        E11            E22            G12            AMU12          ALPHA 1        ALPHA 2        ALPHA12
      0.0000   1000000.0000   100000.0000    100000.0000          .2500          .0100          .0000         0.0000
 TEMPERATURE        E11            E22            G12            AMU12          ALPHA 1        ALPHA 2        ALPHA12
     70.0000    900000.0000    90000.0000     95000.0000          .2500          .0100          .0001         0.0000
```

NODAL POINT	TYPE	X ORDINATE	Y ORDINATE	X LOAD OR DISPLACEMENT	Y LOAD OR DISPLACEMENT	TEMPERATURE
1	0.00	0.00000	0.00000	.5000000E+03	0.	70.000
2	0.00	.08000	.08000	.1000000E+04	0.	70.000
3	0.00	.16000	.16000	.1000000E+04	0.	70.000
4	0.00	.24000	.24000	.1000000E+04	0.	70.000
5	0.00	.32000	.32000	.1000000E+04	0.	70.000
6	0.00	.40000	.40000	.1000000E+04	0.	70.000
7	0.00	.60000	.60000	.1000000E+04	0.	70.000
8	0.00	.80000	.80000	.5000000E+03	0.	70.000
9	0.00	.40000	0.00000	0.	0.	70.000
10	0.00	.48000	.08000	0.	0.	70.000
11	0.00	.56000	.16000	0.	0.	70.000
12	0.00	.64000	.24000	0.	0.	70.000
13	0.00	.72000	.32000	0.	0.	70.000
14	0.00	.80000	.40000	0.	0.	70.000
15	0.00	1.00000	.60000	0.	0.	70.000
16	0.00	1.20000	.80000	0.	0.	70.000
17	0.00	.80000	0.00000	0.	0.	70.000
18	0.00	.88000	.08000	0.	0.	70.000
19	0.00	.96000	.16000	0.	0.	70.000
20	0.00	1.04000	.24000	0.	0.	70.000
21	0.00	1.12000	.32000	0.	0.	70.000
22	0.00	1.20000	.40000	0.	0.	70.000
23	0.00	1.40000	.60000	0.	0.	70.000
24	0.00	1.60000	.80000	0.	0.	70.000
25	0.00	1.60000	0.00000	0.	0.	70.000
26	0.00	1.68000	.08000	0.	0.	70.000
27	0.00	1.76000	.16000	0.	0.	70.000
28	0.00	1.84000	.24000	0.	0.	70.000
29	0.00	1.92000	.32000	0.	0.	70.000
30	0.00	2.00000	.40000	0.	0.	70.000
31	0.00	2.20000	.60000	0.	0.	70.000
32	0.00	2.40000	.80000	0.	0.	70.000
33	0.00	1.80000	0.00000	0.	0.	70.000
34	0.00	1.88000	.08000	0.	0.	70.000
35	0.00	1.96000	.16000	0.	0.	70.000
36	0.00	2.04000	.24000	0.	0.	70.000
37	0.00	2.12000	.32000	0.	0.	70.000
38	0.00	2.20000	.40000	0.	0.	70.000
39	0.00	2.40000	.60000	0.	0.	70.000
40	0.00	2.60000	.80000	0.	0.	70.000
41	0.00	2.20000	0.00000	0.	0.	70.000
42	0.00	2.28000	.08000	0.	0.	70.000
43	0.00	2.36000	.16000	0.	0.	70.000
44	0.00	2.44000	.24000	0.	0.	70.000
45	0.00	2.52000	.32000	0.	0.	70.000
46	0.00	2.60000	.40000	0.	0.	70.000
47	0.00	2.80000	.60000	0.	0.	70.000
48	0.00	3.00000	.80000	0.	0.	70.000
49	0.00	3.00000	0.00000	0.	0.	70.000
50	0.00	3.08000	.08000	0.	0.	70.000
51	0.00	3.16000	.16000	0.	0.	70.000
52	0.00	3.24000	.24000	0.	0.	70.000
53	0.00	3.32000	.32000	0.	0.	70.000
54	0.00	3.40000	.40000	0.	0.	70.000
55	0.00	3.60000	.60000	0.	0.	70.000
56	0.00	3.80000	.80000	0.	0.	70.000
57	1.00	3.40000	0.00000	0.	0.	[illegible]

0. 1.00 4.20000 .80000 0. 0. 70.000

ELEMENT NO.	I	J	K	L	MATERIAL
1	1	9	10	2	1
2	2	10	11	3	1
3	3	11	12	4	1
4	4	12	13	5	1
5	5	13	14	6	2
6	6	14	15	7	2
7	7	15	16	8	2
8	9	17	18	10	1
9	10	18	19	11	1
10	11	19	20	12	1
11	12	20	21	13	1
12	13	21	22	14	2
13	14	22	23	15	2
14	15	23	24	16	2
15	17	25	26	18	1
16	18	26	27	19	1
17	19	27	28	20	1
18	20	28	29	21	1
19	21	29	30	22	2
20	22	30	31	23	2
21	23	31	32	24	2
22	25	33	34	26	1
23	26	34	35	27	1
24	27	35	36	28	1
25	28	36	37	29	1
26	29	37	38	30	2
27	30	38	39	31	2
28	31	39	40	32	2
29	33	41	42	34	1
30	34	42	43	35	1
31	35	43	44	36	1
32	36	44	45	37	1
33	37	45	46	38	2
34	38	46	47	39	2
35	39	47	48	40	2
36	41	49	50	42	1
37	42	50	51	43	1
38	43	51	52	44	1
39	44	52	53	45	1
40	45	53	54	46	2
41	46	54	55	47	2
42	47	55	56	48	2
43	49	57	58	50	1
44	50	58	59	51	1
45	51	59	60	52	1
46	52	60	61	53	1
47	53	61	62	54	2
48	54	62	63	55	2
49	55	63	64	56	2

PRESSURE BOUNDARY CONDITIONS

I	J	PRESSURE I	PRESSURE J
1	9	100.000	100.000
9	17	100.000	100.000
17	25	100.000	100.000
25	33	100.000	100.000
[illegible]	[illegible]	[illegible]	[illegible]

N.P. NUMBER	UX	UY
1	.8005524E-01	-.4741198E+10
2	.7005692E-01	-.4741198E+10
3	.5996704E-01	-.4741198E+10
4	.4973221E-01	-.4741198E+10
5	.3935337E-01	-.4741198E+10
6	.2741146E-01	-.4741198E+10
7	.3719330E-03	-.4741198E+10
8	-.2406120E-01	-.4741198E+10
9	.7505608E-01	-.4741198E+10
10	.6497383E-01	-.4741198E+10
11	.5474186E-01	-.4741198E+10
12	.4442501E-01	-.4741198E+10
13	.3397989E-01	-.4741198E+10
14	.2321601E-01	-.4741198E+10
15	-.2058263E-02	-.4741198E+10
16	-.2502768E-01	-.4741198E+10
17	.7029915E-01	-.4741198E+10
18	.6007014E-01	-.4741198E+10
19	.4981395E-01	-.4741198E+10
20	.3947735E-01	-.4741198E+10
21	.2917957E-01	-.4741198E+10
22	.1903391E-01	-.4741198E+10
23	-.4528999E-02	-.4741198E+10
24	-.2726316E-01	-.4741198E+10
25	.5901909E-01	-.4741198E+10
26	.4361879E-01	-.4741198E+10
27	.3814983E-01	-.4741198E+10
28	.2801085E-01	-.4741198E+10
29	.1821113E-01	-.4741198E+10
30	.1053541E-01	-.4741198E+10
31	-.7527217E-02	-.4741198E+10
32	-.2474785E-01	-.4741198E+10
33	.5647087E-01	-.4741198E+10
34	.4525566E-01	-.4741198E+10
35	.3514099E-01	-.4741198E+10
36	.2550411E-01	-.4741198E+10
37	.1631975E-01	-.4741198E+10
38	.8972645E-02	-.4741198E+10
39	-.7931471E-02	-.4741198E+10
40	-.2252197E-01	-.4741198E+10
41	.4686155E-01	-.4741198E+10
42	.3758430E-01	-.4741198E+10
43	.2842933E-01	-.4741198E+10
44	.1991367E-01	-.4741198E+10
45	.1227236E-01	-.4741198E+10
46	.5455494E-02	-.4741196E+10
47	-.7639835E-02	-.4741198E+10
48	-.1803589E-01	-.4741198E+10
49	.2309608E-01	-.4741198E+10
50	.1516914E-01	-.4741198E+10
51	.9215355E-02	-.4741198E+10
52	.4482269E-02	-.4741198E+10
53	.3807545E-03	-.4741198E+10
54	-.3452351E-03	-.4741196E+10
55	-.3727913E-02	-.4741198E+10
56	-.7768631E-02	-.4741198E+10
[illegible]	[illegible]	-.4741198E+10

64 0. -.4741198E+10

EL.NO.	X	Y	X-STRESS	Y-STRESS	XY-STRESS	X-STRAIN	Y-STRAIN	XY-STRAIN
1	.2400	.0400	-1.2280E+04	-1.8647E+03	-2.4297E+02	-1.2603E-02	2.4414E-03	-7.0190E-04
2	.3200	.1200	-1.2342E+04	-1.2242E+03	-6.1270E+02	-1.2885E-02	3.1738E-03	-1.7700E-03
3	.4000	.2000	-1.2909E+04	-2.2731E+03	-8.8736E+02	-1.3165E-02	2.1973E-03	-2.5635E-03
4	.4800	.2800	-1.2730E+04	-1.1208E+03	-1.2254E+03	-1.3351E-02	3.4180E-03	-3.5400E-03
5	.5600	.3600	-1.1263E+04	-6.0610E+02	-1.5170E+03	-1.1961E-02	2.4414E-04	-1.5869E-02
6	.7000	.5000	-7.9662E+03	-4.2331E+02	-7.3227E+02	-8.2821E-03	1.3428E-03	-7.6599E-03
7	.9000	.7000	-5.4049E+03	-4.4866E+02	-1.1670E+01	-5.4958E-03	3.6621E-04	-1.2207E-04
8	.6400	.0400	-1.2121E+04	-2.9157E+03	-2.2184E+02	-1.2076E-02	1.2207E-03	-6.4087E-04
9	.7200	.1200	-1.2035E+04	-2.0110E+03	-4.2255E+02	-1.2282E-02	2.1973E-03	-1.2207E-03
10	.8000	.2000	-1.1727E+04	-8.2001E+02	-5.7044E+02	-1.2337E-02	3.4180E-03	-1.5479E-03
11	.8800	.2800	-1.1577E+04	-7.7491E+02	-5.9157E+02	-1.2185E-02	3.4180E-03	-1.7090E-03
12	.9600	.3600	-1.0599E+04	-5.8950E+02	-3.5592E+02	-1.1228E-02	2.4414E-04	-3.7231E-03
13	1.1000	.5000	-7.9452E+03	-4.5724E+02	2.2756E+02	-8.3160E-03	9.7656E-04	2.3804E-03
14	1.3000	.7000	-4.6371E+03	-4.8440E+02	3.7343E+02	-4.6328E-03	-2.4414E-04	3.3063E-03
15	1.2400	.0400	-1.3685E+04	-1.7371E+03	-5.0178E+02	-1.4207E-02	3.0518E-03	-1.4496E-03
16	1.3200	.1200	-1.2768E+04	2.0539E+03	-5.1763E+02	-1.4451E-02	6.9580E-03	-1.4954E-03
17	1.4000	.2000	-1.2705E+04	2.2926E+03	7.9228E+01	-1.4460E-02	7.2021E-03	2.2888E-04
18	1.4800	.2800	-1.2307E+04	2.3619E+03	7.9228E+02	-1.4022E-02	7.0801E-03	2.2888E-03
19	1.5600	.3600	-1.1360E+04	-3.6683E+02	1.4310E+03	-1.2136E-02	2.9297E-03	1.4969E-02
20	1.7000	.5000	-6.8006E+03	-3.8119E+02	1.5462E+03	-7.1542E-03	1.5259E-03	1.5174E-02
21	1.9000	.7000	-7.3268E+02	-4.5820E+02	1.1290E+03	-3.0181E-04	-1.0376E-03	1.1810E-02
22	1.7400	.0400	-1.4214E+04	-1.7858E+03	-6.3383E+01	-1.4778E-02	3.1738E-03	-1.3311E-04
23	1.8200	.1200	-1.6512E+04	-5.9908E+03	3.4227E+03	-1.5930E-02	-7.3242E-04	9.3877E-03
24	1.9000	.2000	-1.5204E+04	-8.2531E+03	4.2255E+03	-1.3789E-02	-3.6621E-03	1.2207E-02
25	1.9800	.2800	-1.2066E+04	-5.9755E+03	4.4157E+03	-1.0995E-02	-2.1973E-03	1.2756E-02
26	2.0600	.3600	-8.5135E+03	-1.1306E+03	3.0399E+03	-8.7604E-03	-6.3477E-03	3.1799E-02
27	2.2000	.5000	-5.0497E+03	-6.5951E+02	2.4039E+03	-5.0426E-03	-2.0752E-03	2.5146E-02
28	2.4000	.7000	3.7964E+03	1.7688E+02	2.1005E+02	4.5541E-03	4.7607E-03	2.1973E-03
29	2.0400	.0400	-2.3062E+04	-1.0812E+04	3.6234E+03	-2.1601E-02	-3.9063E-03	1.0468E-02
30	2.1200	.1200	-1.9191E+04	-8.7720E+03	2.9262E+03	-1.7979E-02	-2.9297E-03	8.4534E-03
31	2.2000	.2000	-1.6134E+04	-6.5514E+03	2.5036E+03	-1.5378E-02	-1.4648E-03	7.2327E-03
32	2.2800	.2800	-1.2455E+04	-4.1145E+03	2.1128E+03	-1.2047E-02	0.	6.1035E-03
33	2.3600	.3600	-9.0769E+03	-8.8104E+02	1.3478E+03	-9.4557E-03	-3.4180E-03	1.4099E-02
34	2.5000	.5000	-4.0764E+03	-4.0446E+02	1.0561E+03	-4.0320E-03	4.8828E-04	1.1047E-02
35	2.7000	.7000	4.9286E+03	-3.9907E+02	5.2913E+01	5.9721E-03	-1.9531E-03	5.4932E-04
36	2.6400	.0400	-2.6442E+04	-2.9053E+02	-1.8751E+03	-2.6863E-02	8.9111E-03	-5.4169E-03
37	2.7200	.1200	-2.3990E+04	-6.5371E+02	6.1798E+02	-2.6018E-02	7.6904E-03	1.7853E-03
38	2.8000	.2000	-2.0434E+04	-1.8940E+03	1.9437E+03	-2.1653E-02	5.1270E-03	5.5152E-03
39	2.8800	.2800	-1.6125E+04	-1.2605E+03	2.4719E+03	-1.7077E-02	4.3945E-03	7.1411E-03
40	2.9600	.3600	-1.0459E+04	-6.4593E+02	2.3179E+03	-1.1058E-02	-3.6621E-04	2.4246E-02
41	3.1000	.5000	-1.5409E+03	-5.2784E+02	1.5156E+03	-1.1805E-03	-1.5869E-03	1.3854E-02
42	3.3000	.7000	7.5694E+03	-2.3966E+02	5.8348E+02	8.8620E-03	-9.1553E-04	6.1035E-03
43	3.2400	.0400	-4.2268E+04	3.8605E+03	1.4282E+04	-4.7832E-02	1.8799E-02	4.1260E-02
44	3.3200	.1200	-2.6122E+04	5.6281E+03	1.1705E+04	-3.0481E-02	1.5381E-02	3.3813E-02
45	3.4000	.2000	-1.3707E+04	6.9356E+03	9.1694E+03	-1.7122E-02	1.2695E-02	2.6489E-02
46	3.4800	.2800	-3.4372E+03	8.0391E+03	6.1904E+03	-6.0788E-03	1.0498E-02	1.7883E-02
47	3.5600	.3600	-3.0471E+02	3.2703E+02	3.0487E+03	-4.4405E-05	7.5684E-03	3.1891E-02
48	3.7000	.5000	4.3024E+03	2.6643E+02	2.0480E+03	5.0914E-03	5.6152E-03	2.1423E-02
49	3.9000	.7000	1.2673E+04	3.4386E+02	4.4053E+02	1.4371E-02	4.1504E-03	4.6082E-03

************************* AUTOMATIC BULLETIN ****************************

USEFUL INFORMATION...

1) PERM. FILES FROM 1804, 28 JAN 73 LOADED AT 1759, 29 JAN 73.

2) SYSTEM 279M WAS INTRODUCED ON 02 JAN 73.

3) A COMPLETE AUDIT IS PUT ON PERM FILE EVERY MORNING. IT CAN BE ATTACHED BY THE P.F. NAME (AUDIT,CY=4).

4) PLEASE REVIEW ALL YOUR PERMANENT FILES AND PURGE THOSE THAT ARE NOT ABSOLUTELY NECESSARY.

5) SOFTWARE TESTING... MONDAY THRU FRIDAY (0700-0800).

ANNOUNCEMENTS...

A) A 12 & 1/2 HOUR SCOPE COURSE WILL BE OFFERED ON FEB 26,29, MAR 2,7,9 FROM 0900 TO 1130 IN ROOM 101.

B) A 15 HOUR INTERMEDIATE FTN COURSE WILL BE OFFERED ON MAR 12,14,16,19,21,23 FROM 0900 TO 1130 IN ROOM 101.

C) TO REGISTER CONTACT TOM KELLER, ASD/DPCD, 56351/54442.

D) SOFTWARE PRODUCT TEST:

A LIVE TEST IN THE PRODUCTION ENVIRONMENT WILL BE CONDUCTED DURING THE PERIOD (7 FEB THRU 9 FEB 73).

THE FOLLOWING PRODUCTS WILL BE IN TEST MODE:

SIMSCRIPT 3.0

THE ABOVE PRODUCTS ARE OFFERED FOR TESTING AND MAY MALFUNCTION IN SOME CASES; THEREFORE PLEASE REPORT ANY PROBLEMS AS SOON AS POSSIBLE TO EXT. 56248 AND SAVE SUPPORTING DOCUMENTATION.

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02/02/73  SCOPE 3.3 R2 CMR1    L279R2M    01/01/73
17.05.43.TJMT200
17.05.43.TJM,T45,CM177000.D720633,MUHA,FBCB,55548
17.05.43.
17.05.44.FTN.
17.06.40.     28.917 CP SECONDS COMPILATION TIME
17.06.40.LGO.
17.06.45. MINIMUM FIELD LENGTH REQUIRED  176200
17.06.51.STOP
17.06.52.MAXIMUM MASS STORAGE   000450 PRUS
17.06.52.CP      031.332 SEC.
17.06.52.PP      015.568 SEC.
17.06.52.IO      014.085 SEC.
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